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ABSTRACT

The purposes of this study were to: (1) examine the psychometric properties of the Ball Aptitude Battery (BAB) on a high school freshman sample; (2) develop BAB norms for high school freshmen; (3) develop and evaluate four memory tests and a vocabulary test appropriate for freshmen; (4) examine level and structure differences for the BAB tests across race and sex groups within the freshman sample; and (5) examine the differentiation hypothesis. Subjects were 445 freshmen from nine Chicago area high schools. Results indicated that: (1) except for the vocabulary test which is too difficult, the BAB has adequate psychometric properties with a freshmen sample; (2) all the memory tests warrant further development for possible inclusion in the BAB; (3) level differences across race and sex groups in the freshmen sample were in expected directions, but two distinct factor patterns appeared. Because clear differences in both level and structure were found between high school freshmen and seniors, separate freshman norms were constructed. Further research is needed before conclusions can be made on the differentiation hypothesis. (Author/BS)

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TECHNICAL REPORT

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GENERALIZATION AND EXPANSION OF THE BALL APTITUDE BATTERY

TO HIGH SCHOOL FRESHMEN

Elizabeth K. Rangel
University of Minnesota

Hei-Ki Dong and Stephen M. Colarelli
The Ball Foundation

1984

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BALL FOUNDATION

Technical Report No. 16

GENERALIZATION AND EXPANSION OF THE BALL APTITUTDE BATTERY TO HIGH SCHOOL FRESHMEN

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August, 1984

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ABSTRACT

This study was conducted to examine the general properties of the Ball Aptitude Battery (BAB) with high school freshmen. Specifically, the purposes of this study were: (a) examine the psychometric properties of the BAB on a high school freshman sample, (b) develop BAB norms for high school freshmen, (c) develop and evaluate four memory tests and a vocabulary test appropriate for freshmen, (d) examine level and structure differences for the BAB tests across race and sex groups within the freshman sample, and (e) examine the differentiation hypothesis. Subjects were 445 freshmen from nine Chicago area high schools.

Results indicated that the BAB, with the exception of the Vocabulary test, has adequate psychometric properties with a high school freshmen sample. However, the Vocabulary test in its present form is too difficult for high school freshmen. All memory tests displayed adequate psychometric properties to warrant further development and possible inclusion into the BAB. Especially promising are the Associative and Auditory memory tests. Results from investigation of the level and structure differences for the BAB tests across race and sex groups within the freshman sample showed that there were some level differences across different groups, but they were, by and large, all in the expected direction. However, when the factor structures from the two sex groups and three ethnic groups were examined, two distinct types of factor pattern appeared: 5-factor pattern emerged clearly in the two sex groups, whereas 7 to 11 factors emerged clearly in the three ethnic groups. When level and structure differences were examined between high

school freshmen and seniors, the results showed clear differences in both. Means and standard deviations for the two samples indicated that the seniors performed better on all tests except Shape Assembly, and they showed higher variability on most tests. Marked differences were observed between the factor structures for the two age groups. The senior sample showed 10 well defined factors replicated across each ethnic and sex group; freshmen groups showed varying number of factors from 5 in both sex groups to 11 in one of the ethnic groups. Because the results indicated that two age groups differed in both level and structure, a separate norm for the freshman sample was constructed and recommended to interpret their scores.

Recommendations on applicability of each of the BAB and experimental tests to both high school freshmen and seniors as well as suggestions on future research directions are given in the discussion section.

Generalization and Expansion of the Ball Aptitude Battery to High School Freshmen

INTRODUCTION

The Ball Aptitude Battery (BAB) is a multiple aptitude battery consisting of 14 measures of cognitive and psychomotor skills. It was developed by the Ball Foundation in the tradition of Johnson O'Connor's (1935) "work sample" approach for the purpose of estimating aptitudes or potential for learning specific work-related skills. The psychometric properties of the BAB have been demonstrated to meet satisfactorily the criteria for a sound instrument (Sung & Dawis, 1981; Dohm & Sung, Note 1). Moreover, evidence for the independence of the BAB tests is provided by factor analyses in which most tests clearly loaded on only one factor (Sung & Dawis, 1981).

The data for BAB test development was obtained on a heterogeneous sample of 1,600 adults between the ages of 18 and 64. To continue the development of the BAB, it is important to investigate the psychometric properties of the battery for populations of varying ages and backgrounds. In particular, it is desirable to examine the appropriateness of the BAB for younger age groups below the senior year of high school. Therefore, the first purpose of the present study is to investigate psychometric properties of the BAB for high school freshmen. The BAB tests will be individually examined, and recommendations for revisions appropriate to the freshman level will be made.

A second objective of the present study is the production of BAB test norms for freshmen. Existing norms were developed on adult samples of high school senior age and above. A standardization sample of 600 Illinois and Texas students provided BAB test norms for high school seniors tested in 1977 and 1978. Three racial groups, black, hispanic, and white, were represented equally within the standardization sample. The large size and ethnic diversity of the BAB's norm sample make the BAB unique when compared to other test batteries. For example, the norms for the Comprehensive Abilities Battery (CAB) were developed from a sample composed almost entirely of white high school students of unspecified grade level from western Canada (Hakstian & Cattell, 1976). BAB norms have been developed for high school seniors and for adults above the age of 18. If the battery meets the criteria of a sound instrument for freshmen, BAB test norms will be developed for this age group.

The third objective of the study is the development and evaluation of four experimental tests. The 14 tests of the BAB measure a wide range of cognitive and psychomotor abilities, but they do not include a test of memory. The importance of memory as a group factor has been recognized since Thurstone's early factor analytic work in the 1930's (Tyler, 1965). Four experimental tests were constructed, each designed to tap a separate aspect of human memory. Short-term rote memory of non-meaningful letter/number pairs was measured by a test of associative memory. Two memory span tests were developed involving the presentation of a series of number sequences of varying lengths. Each series is followed by an immediate test of the subjects' recall. The memory span tests use similar test material (digit strings) presented in contrasting

sensory modes, auditory and visual. The fourth experimental test is a measure of facial memory with testing immediate and delayed recognition of previously studied faces.

The fourth purpose of the present study is the examination of level and structure differences for the BAB tests across race and sex groups within the freshman sample. A study of high school seniors (Sung & Dawis, 1981) concluded that race and sex had little effect on factor structure, despite appreciable group differences in test level. The factor structures for the different groups were highly similar, with 10 well-defined factors replicated across all groups. Other researchers have reported findings of factor correspondence across ethnic groups (DeFries et al., 1974). The present study will examine group differences in test level and structure among freshmen. On the basis of the Sung & Dawis (1981) findings, it is expected that level differences, but not structure differences, will be observed across the race and sex groups. In addition, comparisons of BAB mean test scores will be made between the freshmen from the present study and the senior sample as reported by Sung and Dawis (1981).

The final purpose of the freshman study is to provide a test for the differentiation of abilities with age. It has been hypothesized that abstract intelligence changes in its organization with age, from a fairly undifferentiated general ability in early childhood to increasingly specialized and distinct abilities by late adolescence (Garrett, 1946; Anastasi, 1970). Early investigations of the differentiation hypothesis yielded inconclusive results, which Burt (1954) attributed to their methodological weaknesses. More recent work using appropriate

procedures and instruments has generally supported the hypothesis of increasingly differentiated abilities between the approximate ages of 3 and 18. By way of illustration, a study of Quereshi (1967) reported strong evidence for the differentiation of psycholinguistic abilities in a cross-sectional study of children between the ages of 2 and 9. The evidence for differentiation of abilities among adult groups is less conclusive and probably affected by differences in education to some degree (Anastasi, 1970). Most of the relevant research has employed ability measures encompassing a relatively restricted portion of the ability domain, e.g., psycholinguistic abilities or WISC subtests (Osborne & Suddick, 1972; Quereshi, 1967). The present study is to test the differentiation hypothesis among adolescents of both sexes and several ethnic groups, using a test battery composed of a variety of aptitude measures, the BAB. A comparison will be made between the BAB factor structures for the freshmen in the present study and the seniors as reported by Sung and Dawis (1981).

The proposed test of the differentiation hypothesis is limited by its use of a cross-sectional design. Differences in factor structure may be due to sampling differences or other factors besides age differences. Thus this study will become the basis for a longitudinal study in which research participants will be retested with the BAB three years hence during their senior year of high school.[1] The proposed longitudinal study would examine the stability of aptitudes during adolescence, as well as testing the hypothesis of increasingly differentiated abilities.

METHOD

Subjects

The participants in the present study were 445 freshmen from nine Chicago area high schools. Subjects' ages range from 13 to 16 years of age, with a mean age of 14.31 and standard deviation of 0.58. Their distribution by race and sex is shown in Table 1. High schools were

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Insert Table 1 about here

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selected to provide a diversity of subjects with respect to location, socio-economic status, sex, and racial group membership. Three public and six private schools provided 28 percent and 72 percent of the subjects, respectively. The method for selecting research participants varied at each school. At some schools, sampling was random, or nearly so; at others, participation was on a volunteer basis.

Instrumentation

The instruments used were the BAB, two numerical tests, five experimental tests, a research form of the Self-Directed Search, and a biographical inventory.

BAB. The BAB is a multiple aptitude battery consisting of 14 aptitude measures. The 14 tests are described below and listed in the order in which they were administered.

1. Clerical Test: Measures the ability to perceive visual details, similarities, and differences.

2. Idea Fluency: Measures the ability to produce ideas of alternative uses for a given object.

3. Inductive Reasoning: Measures the ability to identify a rule; to reason from specific information to a general principle.

4. Word Association: Measures the similarity of response to the normative word-association response.

5. Writing Speed: Measures the ability to write fast.

6. Paper Folding: Measures the ability to visualize in two-dimensional space.

7. Vocabulary: Measures the ability to choose the right word that represents an idea.

8. Ideaphoria: Measures the ability to generate a rapid and abundant flow of words and ideas.

9. Finger Dexterity-Left: Measures the ability of the left hand to make skillful, controlled manipulations of small objects, principally involving finger movement.

10. Finger Dexterity-Right: Same as 9 for the right hand.

11. Grip-Left: Measures the strength of grip of the left hand.

12. Grip-Right: Same as 11 for the right hand.

13. Analytical Reasoning: Measures the ability to reason from a general principle to specific information and from specific examples to a general principle; the ability to organize related concepts in a systematic manner.

14. Shape Assembly: Measures the ability to visualize in three-dimensional space.

The Tonal Memory and Pitch Discrimination tests, included in Sung and Dawis' (1981) study of high school seniors, have been deleted from the BAB and were not included in the present study.

The summary characteristics of the BAB tests, including reliability estimates, are presented in Table 2. The mean six-week test-retest

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Insert Table 2 about here

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reliability for the total reliability study sample was .82. Good concurrent and construct validities of the BAB have been documented in studies by Dohm and Sung (Note 1, Note 2) and Sung and Dawis (1981).

Numerical tests. Subjects were administered two numerical tests developed in a previous Ball Foundation study (Sung, Note 3), Numerical Ability and Numerical Reasoning. The Numerical Ability test measures the ability to perform simple arithmetic computations quickly and accurately. Numerical Reasoning is a measure of the ability to identify a pattern or rule underlying a sequence of numbers, and to apply that rule to generate the next number in the series. Table 3 shows the number of items, work times, and reliability estimates for the numerical tests.

Insert Table 3 about here

Experimental tests. Five experimental tests were developed, including a research form of the Vocabulary test and four tests designed to tap several aspects of memory. It was determined that the BAB Vocabulary test in its present form might be too difficult for high school freshmen. When administered to high school seniors in 1977-1978, alternate forms of the Vocabulary test produced total score distribution skewed to the right to a moderate degree. The administration of the present form of Vocabulary would probably produce an even more pronounced skew, or "floor effect." To develop a vocabulary test of appropriate difficulty for freshmen, a research vocabulary test of greater simplicity was constructed and administered in addition to the standard BAB Vocabulary test.

The four memory tests are described briefly as follows:

1. Associative Memory: Measures the ability to recall the letter originally paired with a number immediately after studying a list of number/letter pairs.

2. Auditory Memory Span: Measures the ability to remember series of digits presented auditorily by means of a pre-recorded tape.

3. Visual Memory Span: Measures the ability to remember series of digits presented visually by means of slides projected onto a screen.

4. Facial Memory: Measures the ability to recognize a set of previously studied Identi-Kit constructed faces from a larger set of both old and new faces. Recognition tests were administered immediately after study and again after a half hour interval of unrelated testing.

Detail description of how the research vocabulary and memory tests were developed are presented in Appendix A.

Self-Directed Search. Subjects were given a research form of Holland's Self-Directed Search (SDS). The SDS provides scores on six occupational interest themes: Realistic, Investigative, Artistic, Social, Enterprising, and Conventional. Theme scores are converted into T-scores, which in Holland's standardization sample have a mean of 50 and a standard deviation of 10.

Biographical Inventory. Information about the subjects' hobbies, career plans, parental occupation, and family income was gathered by means of a biographical inventory.

Data Collection

The tests were administered in two separate sessions at each school by Ball Foundation test administrators. The first eight BAB tests and the numerical tests were given in a group testing session lasting

approximately three hours. The remaining BAB tests were administered individually in sessions ranging from 45 minutes to 90 minutes. One or more of the experimental tests were given during each group session. Group and individual testing took place in the classrooms, conference rooms and/or the library of each participating school.

The percentages of subjects completing each set of tests were 99 percent for the BAB group tests, 94 percent for the BAB individual tests, 99 percent for the numerical tests, 80 percent for the SDS, and 74 percent for the biographical inventory.

All testing was carried out in accordance with the procedures outlined in the Test Administrator's Manual (Sung, Dawis, & Dohm, 1981), with the exception of the time limits for Shape Assembly and Analytical Reasoning. Because sample consisted of freshmen time limits for these tests were increased by 50 percent, ensuring ample completion times to obtain estimates of item difficulties.

Data Analysis

The test protocols were hand-scored and processed for computer analysis. The data analyses were carried out on a CDC 6700 computer using SPSS Version 8.0 programs.

Four series of data analyses were performed: (a) a study of the psychometric properties of the BAB and numerical tests for high school freshmen; (b) similar analyses of the experimental test data; (c) an examination of level differences in test scores for the separate race and sex groups; and (d) an investigation of the influence of race, sex, and age on BAB factor structure.

First, traditional test development and item analysis procedures were used to examine the applicability of the BAB for high school freshmen. For each test, frequency distributions were generated and inspected in terms of their means, standard deviations, ranges, and skewness. Item analyses were conducted and estimates of internal consistency reliability calculated for the relatively unspeeded tests with appropriate item formats, i.e., Paper Folding, Vocabulary, Inductive Reasoning, Shape Assembly, Analytical Reasoning, and then numerical tests. Test norms for both sexes were developed and reported in percentile form.

Second, the experimetnal tests were examined with respect to their descriptive statistics, reliability estimates, intercorrelations, and correlations with the BAB tests. Item analyses were conducted for the two memory span tests.

Third, level differences in BAB test scores were examined for the different race and sex groups. In addition, the mean test scores of the freshman sample were compared to the mean scores of high school seniors from the sample used in Sung and Dawis (1981) study.

Fourth, the pattern and factor structure of the BAB (including the numerical tests) were investigated. Test intercorrelation matrices were constructed for the total sample and for each race and sex group and compared in terms of the sizes and patterns of the inter-test correlations. The influence of sex and race on factor structure was investigated by a series of factor analyses of the data for each race and sex group. Coeffficients of factor congruence (Harman, 1976) were calculated between the corresponding factors for the different race and sex

groups. Due to the small size of the hispanic sample (N=42), factor comparisons between the race groups was limited to the black/white comparison. Finally, coefficients of factor congruence were computed between the corresponding race or sex groups across the two age groups, the freshmen in the present study and the seniors in the Sung and Dawis (1981) study. That is, the factors identified in the analysis of the freshman male data were compared to the factors obtained for senior males, the factors for freshman blacks were compared to the factors for senior blacks, and so forth. The comparison between hispanic freshmen and seniors was omitted because of the small size of the hispanic freshman sample.

In addition to the aptitude test data analysis, occupational interests among freshmen were investigated, based on the six theme scores of the SDS. Means and standard deviations were calculated for each theme, and the six theme scores were correlated among themselves and with the BAB tests.

RESULTS

This section presents the results of our analyses discussed in the preceding section. First, the psychometric properties of the BAB for high school freshmen are presented. Second, results from the analyses of the experimental tests of memory and vocabulary are given. Third, an examination of group differences in level and in pattern and factor structure of the BAB is presented. And finally, results from comparing BAB level and factor structure differences between freshmen and seniors are given in the last part.

Psychometric Properties of the BAB for High School Freshmen

The psychometric properties of the BAB for high school freshmen were investigated in the following ways: first, each test was examined in terms of its item difficulty and discrimination indices, estimates of internal consistency reliability, and the shape of the distribution of total scores. Second, comparisons were made between the results of the present study and the study of high school seniors (Sung & Dawis, 1981).

Item Difficulties and Discrimination

Seven BAB tests (Inductive Reasoning, Paper Folding, Vocabulary, Analytical Reasoning, Shape Assembly, Numerical Ability, and Numerical Reasoning) consisting of dichotomously scored items suitable for item analysis were inspected in terms of their item characteristics. Frequency distributions of item difficulties and discrimination indices for each test are presented in Tables 4 and 5. A wide range of mean item difficulties was observed, from .33 for Vocabulary to .74 for Shape

Insert Tables 4 and 5 about here

Assembly, with a median item difficulty estimate of .44. Item discrimination indices for most tests varies between .00 and .60, with most items showing an item-total correlation greater than .20. Detailed item analyses for each test are given in Appendix B.

Reliabilities

Table 6 shows test reliabilities estimated by coefficient alpha and

Insert Table 6 about here

the split-half method for the total group and for each sex group. Each test showed similar reliability estimates across all three groups. Within each sample, coefficient alpha was invariably higher than the split-half estimate. Alpha coefficients for the combined sample ranged from a low of .60 for Shape Assembly to a high of .91 for Vocabulary, Numerical Ability, and Numerical Reasoning, with a median value of .80. The tests with the lowest reliabilities, Shape Assembly and Inductive Reasoning (.60 and .62, respectively), were also characterized by the fewest number of items (six for Shape Assembly) and the lowest average item-total correlations (median rof .20 for Inductive Reasoning).

Distribution of Scores

With three exceptions, the BAB tests demonstrated large ranges and approximately normal and symmetrical total score distributions. The exceptions were Writing Speed, Vocabulary, and Numerical Reasoning, all showing total score distributions skewed to the right to varying degrees. Numerical Reasoning displayed the most symmetrical distribution of the three, but the modal score was zero. Mean item difficulties for Vocabulary and Numerical Reasoning were .33 and .35, respectively.

The means, standard deviations, and other descriptive statistics for each BAB test are presented in Appendix B.

Numerical Long and Short Form Test Correlations

The numerical tests were further investigated by examining the correlations among the full scale and short scale forms of each test. All references to numerical test scores in this report refer to scores on the short scale. The 20 items comprising each short scale are listed in

Table 7. Intercorrelations among the full scales and short scales of each numerical test are shown in Table 8. Correlations

Insert Tables 7 and 8 about here

between the long and short forms of each test were very high (.97 and .96), and cross-correlations were consistently within the range of .74 to .76.

Mean Differences Between Freshmen and Seniors

Finally, the BAB's psychometric properties for freshmen were examined by comparing test means and standard deviations of the freshman sample with seniors used in the Sung and Dawis (1981) study. The comparisons were made to check the expectations that: (a) seniors would score at least high or higher than freshmen, due to greater maturation or educational experience or both, and (b) seniors would display equal or greater variability than freshmen because of greater individual differences. Test score means and standard deviations for the two groups are presented in Table 9. The senior sample showed higher mean scores for every test except Shape Assembly, for which freshmen showed a slight

Insert Table 9 about here

advantage. The magnitude of the differences between the two samples corresponded roughly to a prior expectation about the development of particular aptitudes. For example, the relatively large difference in Grip scores is probably due to greater physical maturation, while little change was seen in Word Association.

A comparison of standard deviations for the two groups showed that with the exceptions of Clerical and Writing Speed, the dispersion of freshmen test scores was less than or approximately equal to that for seniors.

Freshman Norms

The mean score differences between the freshmen and seniors indicated a need for freshman norms. Thus the second object of the present study was met by the development of percentile norms for both sex groups. The freshman norms are presented in Tables 10 and 11.

Insert Tables 10 and 11 about here

Psychometric Properties of the Experimental Tests

Memory Tests

The third objective of the freshman study was the development of four experimental memory tests: Associative Memory, Visual Memory Span, Auditory Memory Span, and Facial Memory. Appendix A contains a description of the construction of each new test. The memory tests were submitted to the same analyses as those carried out for the BAB tests.

Item Difficulties and Discriminations. Frequency distributions of item difficulties and discrimination functions for the two memory span tests are presented in Table 12. For the Auditory Memory Span test, item difficulties ranged from .10 to .64, with over half of the 25 items

Insert Table 12 about here

showing difficulty values less than .30. The mean item difficulty was .29. Item discrimination indices were generally high, with 22 items showing item-total correlations of .40 or greater.

Item difficulties for the Visual Memory Span test ranged from .22 to 1.00, with a mean difficulty value of .71. However, a cluster of 10 very easy items appeared, with item difficulties of .90 or greater. Item discrimination indices were fairly evenly distributed between .00 and .60. A more detailed item analysis in Appendix C shows that the easiest items were also characterized by the lowest item discrimination functions.

When the items of either memory span test were grouped according to digit series length, it was evident that mean item difficulty steadily increased as a function of series length. For example, mean Auditory Memory Span item difficulties for the longest and shortest series (i.e., 5 and 10 digits) were .52 and .18, respectively.

Reliabilities. Reliability estimates for the experimental tests are presented in Table 13. Alpha coefficients were high (.81 and above) for Research Vocabulary and the two memory span tests. Facial memory

Insert Table 13 about here

test reliabilities were uniformly very low, ranging from .06 to .29.

Mean differences between groups. The psychometric properties of the Associative Memory and Facial Memory tests were further investigated by calculating means and standard deviations for freshmen and other groups. Table 14 shows descriptive statistics for the Associative

Insert Table 14 about here

Memory test for four groups: high school freshmen, longitudinal follow-up subjects, community clients, and Ball employees. For one group of

freshmen (from school 426) the length of the study period was either 1-1/2 or two minutes. Subsequent test administrations used a two-minute study period. Among the three freshman groups, mean scores varied between 5.30 and 6.11, all higher than the adult means of 5.04 and 4.17 for the Ball employees and community clients. Standard deviations were roughly equivalent for the three groups, with the Ball employees showing the highest variability.

Descriptive statistics for both forms of the Facial Memory test are shown in Table 15. Because the number of responses often deviated from

Insert Table 15 about here

the seven or nine responses specified in the directions, test means and standard deviations were reported for both the total group and for the subset of subjects with the correct number of responses. The latter group consistently achieved higher mean scores. A striking finding in this table was the stability of test scores over time for both forms. The correlations between performance on the immediate and delayed recognition tests for the two forms were .51 and .50. If these statistics are considered as estimates of test-retest reliability, they are somewhat higher than the internal consistency reliability estimates shown previously in Table 13.

Sex and race differences in Facial Memory test scores are presented in Table 16. Mean scores for whites were invariably higher than for

Insert Table 16 about here

blacks for both test forms and both testing times, immediate and delayed. No consistent sex differences were evident. Again the stability of test scores over the delayed period is seen for both race and sex groups.

Research Vocabulary

A detailed item analysis of the 126-item Research Vocabulary test is presented in Appendix C. As shown in Table 13, test reliabilities estimated by coefficient alpha and the split-half method were high at .95 and .88, respectively.

Test Intercorrelations

Next, selected experimental tests were correlated with BAB tests as shown in Table 17. Several BAB tests showed moderate to high correla-

Insert Table 17 about here

tions with Research Vocabulary and Research Vocabulary; in particular, the correlation between BAB Vocabulary and Research Vocabulary was .90. BAB correlations were lower for the three memory tests. The Associative Memory test showed BAB correlations of .20 or less, while the Facial Memory test (form 7/18), both immediate and delayed, showed correlations ranging between .11 (Grip-Left) and .52 (Analytical Reasoning). High correlations were also observed with Vocabulary, Ideaphoria, Finger Dexterity-Right, and Idea Fluency.

Level and Structure Differences Across Different High School Freshmen Groups

The fourth purpose of the freshmen study was the investigation of group differences in level, pattern, and factor structure of the BAB.

Mean Differences

Means and standard deviations for the different race and sex groups are presented in Table 18. Sex differences, when they occurred, were

Insert Table 18 about here

generally in the expected directions; higher mean scores on Paper Folding, Shape Assembly, and Grip for males, and Clerical and Ideaphoria for females. The females also scored higher on Writing Speed, but did not show the traditional advantage over males on Vocabulary. No meaningful sex differences were observed for the other BAB tests.

The three race groups, black, hispanic, and white, showed little or no differences on Word Association, Writing Speed, Finger Dexterity, and Grip. The largest race differences were seen on Idea Fluency, Paper Folding, Vocabulary, Ideaphoria, Analytical Reasoning, Shape Assembly, and the numerical tests. When race differences were evident, a consistent rank ordering was found: in descending order of mean test scores, white, hispanic, and black. However, these findings should be considered in the context of the fact that relevant covariates, such as social class, were not controlled.

Test Intercorrelations By Group

Next, the influence of race and sex on patterns of BAB test intercorrelations was examined. Intercorrelations matrices for the total group and for the separate race and sex groups are presented in Tables 19 to 21. It can be seen that the patterns of correlations are rather

Insert Tables 19, 20, and 21 about here

similar across all groups. The median correlation for the total group was .17, and median rs for the race and sex groups varied between .10 and .18.

Factor Structure Differences

The influence of race and sex on factor structure was investigated by factor analyses of the data for each race and sex group. The factor analysis method used was a principal factors solution with interations, followed by orthogonal rotation to a varimax criterion. The number of factors extracted was set at 13, this being the maximum number of factors expected if each test (with the exceptions of the pairs of dexterity, of grip, and spatial tests) was independent of the others.

Factor loading matrices for the total group and for the separate race and sex groups are presented in Tables 22 to 27. To highlight the results, only factor loadings of .30 or higher are included. The factor

Insert Tables 22, 23, 24, 25, 26, and 27 about here

analysis of the small hispanic data set (N=42) should be interpreted with caution. In addition, a non-white group was formed by combining the black and hispanic samples. The factor analytic results for the combined non-white group are presented in Table 28.

Insert Table 28 about here

Among the six freshman groups (total group, two sex groups, three race groups), one of two fairly well-defined factor patterns appeared. Only 5 factors emerged clearly in the analysis of the data from the total group and the two sex groups. In those three groups, a large general factor was the first to appear, with high loadings on Idea Fluency,

Paper Folding, Vocabulary, Shape Assembly, Numerical Ability, and Numerical Reasoning. Each group also showed well-defined factors for Grip, Finger Dexterity, and Clerical.

The factor analytic results for the three race groups and the combined non-white group showed a different pattern. The data for each group yielded between 7 to 11 factors, none of which resembled the general factor observed in the analyses of the sex group data. Within each race and each group, factors emerged clearly for Grip, Finger Dexterity, spatial (loaded highly by both Paper Folding and Shape Assembly), Writing Speed, and Ideaphoria. Factors for Word Association and Inductive Reasoning appeared in the analyses for the three race groups, but not in the non-white group. The variance of the remaining tests tended to be divided among several factors.

The factor analytic results for each group are presented in summary for in Table 29. Test communalities and highest factor loadings are listed by race and sex group.

Insert Table 29 about here

Level and Structure Differences Between High School Freshmen and Seniors

The final purpose of the present study was to make a cross-sectional comparison of BAB test level and factor structure between freshmen and seniors. The senior sample used here is that used in the Sung and Dawis study (1981).

Mean Differences

Means and standard deviations for the two age groups were presented previously in Table 9. Mean comparisons showed that the seniors held the advantage on all tests except Shape Assembly.

Factor Structure Differences

Comparisons of BAB pattern and factor structure for the two groups are complicated by the fact that the freshmen and seniors were administered somewhat different test batteries. Pattern and factor structure differences should be interpreted in light of the fact that the seniors were not given the two numerical tests, and the freshmen did not take the three music tests.

BAB test intercorrelations for the separate sex and race groups of the high school senior sample are presented by Sung and Dawis (1981). Patterns of inter-test correlations were rather similar for the freshman and senior groups. Both age groups showed low median correlations, ranging from .10 to .18 for the freshman groups and .15 to .19 for the senior groups.

Marked differences were observed between the factor structures for the two age groups. The senior sample showed 10 well-defined factors replicated across each race and sex group (Sung & Dawis, 1981). Moreover, in most cases each BAB test clearly loaded on only one factor. The factor structures for the freshman groups have already been described. The factor structures for the three freshman race groups bore some resemblance to the factor structures of the senior groups.

Coefficients of factor congruence between race and sex groups of the freshman sample are presented in Table 30. Comparisons of race

Insert Table 30 about here

groups are limited to the blacks and whites; the hispanic sample was omitted due to its small sample size. Factors for grip and finger dexterity shows the highest similarity in both race and sex group comparisons. Factor congruence between blacks and whites was also high for the spatial factor.

Coefficients of factor congruence were also calculated between freshmen and seniors of both sexes and two race groups, black and white. Again, the factors for Finger Dexterity and Grip showed the highest congruence across all groups. Other highly similar factors were the spatial factor in the two race group comparisons, and Ideaphoria for the male group and white group. Factor congruence coefficients for other group comparisons ranged between .70 to .90.

SDS and BAB

Descriptive statistics on freshmen's SDS scores and its relation with the BAB are presented in Appendix D.

DISCUSSION

Recommendations for Revision of BAB Tests for Freshmen

Each of the fourteen BAB tests and the two numerical tests was evaluated in terms of its appropriateness for high school freshmen. The statistical criteria used for evaluation included the following:

1. Large range of total scores.
2. A mean near the mid-range of total possible points.
3. Standard deviation of moderate size.
4. Skewness coefficient near zero, and roughly equivalent mean and median.
5. Item difficulty levels within the range of .10 and .90, averaging near .50.
6. Item discrimination functions of .20 or greater.
7. Reliability coefficient greater than .60, and preferably greater than .80.

This section contains recommendations for the revision of the BAB tests for use with freshmen. Two types of tests are discussed: first, highly speeded tests and/or tests otherwise unsuitable for item analysis (Clerical, Idea Fluency, Word Association, Writing Speed, Ideaphoria, Finger Dexterity, and Grip), and second, moderately speeded tests with item formats permitting item analyses and analyses of internal consistency reliability (Inductive Reasoning, Paper Folding, Vocabulary, Analytical Reasoning, Shape Assembly, Numerical Ability, and Numerical Reasoning).

Highly Speeded Tests

Descriptive statistics for the speeded tests, including means, standard deviations, medians, and ranges, are presented in Table 31.

Clerical. No revisions are indicated. However, some test-takers have been observed to return to the Clerical test during the administration of other tests. An explicit prohibition in the instructions would probably eliminate this behavior.

Idea Fluency. A number of freshman students appeared to have misunderstood the instructions for Idea Fluency. Test-takers are given

the name of a common object (such as "pencil") and asked to write down as many uses for that object as possible (e.g., "write a letter," "poke holes," etc.). Many freshmen responded with free associates to the object (such as "hard" for "rock") or similar uses for the same object (such as "grow apples" and "grow cherries" for "trees"). The problem was alleviated somewhat with the following addition to the instructions:

> Try to be specific in your answers, and don't list several answers that describe almost the same use, such as "write a letter" for the object "pencil".

It is recommended that the new paragraph be added permanently to the test instructions. In addition, a sentence presently in the instructions stating that "There are no right or wrong answers." should be re-evaluated and possibly omitted.

Word Association. No revisions are indicated.

Writing Speed. The large positive skew (+2.13) is probably a reflection of the tendency for a few test-takers to return to the Writing Speed test during the administration of another test. This problem could be reduced by closer proctoring, adding an explicit prohibition to the test instructions, and/or eliminating from the analysis all scores of 300 or above (four standard deviations above the mean).

Ideaphoria. No revisions are indicated.

Finger Dexterity. No revisions are indicated.

Grip. No revisions are indicated. The moderately elevated skew coefficients (+.570, +.501) are probably the result of a few high-scoring males.

Moderately Speeded Tests Suitable for Item Analysis

Descriptive statistics and detailed item analyses for the tests in this section were presented in Appendix B.

Inductive Reasoning. The Inductive Reasoning test demonstrated a wide range and a fairly symmetrical distribution of total scores. However, the item analysis revealed a number of very easy items (7 items with difficulties greater than .90) and generally low item-total correlations (r less than .20 for 14 items). The latter finding was manifested in the relatively low reliability coefficients of about .60.

It is recommended that the Inductive Reasoning test be revised by: (a) deleting most or all of the items with p-values greater than .90, and (b) deleting the items with the lowest item discrimination functions, particularly item number 13. The reliability of the resulting 24- or 25-item test would probably remain low; the addition of 5 or 6 fairly difficult and cohesive new items would increase test reliability and provide finer discrimination among test-takers scoring above the mean.

Vocabulary. The Vocabulary test demonstrated high internal consistency reliability (alpha of .91) and a wide range of scores. However, the positively skewed distribution of total scores (skew coefficient of +1.10) and the low mean item difficulty of .33 are clear indications that the test in its present form is too difficult for freshmen.

The construction of the Research Vocabulary test was described in Appendix A. For the 235 freshmen taking both the BAB and Research Vocabulary tests, a pool of 206 vocabulary items was formed. A Freshman Vocabulary test was constructed by selecting 80 items from both vocabulary tests according to the criteria of: (a) p-values between .10 and .90, and averaging near .50, and (b) item discrimination functions greater than .20. The item format of the suggested freshman test is shown in Table 32. The 80-item test contains 26 items from the BAB

Insert Table 32 about here

Vocabulary test and 54 items drawn from the Research Vocabulary test. Table 33 shows the frequency distribution of item difficulties and discrimination indices for the suggested Freshman Vocabulary test. The

Insert Table 33 about here

average item difficulty for the new test is .53, and all item discrimination functions are equal to or greater than .30.

Paper Folding. Most test items displayed good characteristics and test reliability was in the acceptable range (alpha of .80). However, the last 4 items (numbers 21 through 24) were both very difficult (p-values less than .20) and poor discriminators (r less than .20). These items were also characterized by a fairly abrupt drop in the number of responses made after the previous 20 items. It is likely that the placement of the last 4 items on the last page of the test, requiring a page turn to reach them, is responsible in part for their poor showing. Future versions of the BAB should either (a) delete items 21 21 through 24, or (b) arrange the items on the test pages such that no items are easily overlooked.

Analytical Reasoning. Several items with low item-total correlations (numbers 1 and 8) and extreme p-values (number 2) should be re-evaluated and possibly deleted from the test. The standard time limits for several items should be increased such that 95 percent of the freshman test-taker complete the item. The currently used time limits, developed for high school seniors, are occasionally too short for some accurate but slow-working freshmen.

Numerical Ability. No revisions are indicated.

Numerical Reasoning. The Numerical Reasoning test demonstrated high internal consistency reliability (alpha of .91) and very high item discrimination functions (.50 or greater for 17 of the 20 items). However, the extreme difficulty of the test for freshmen was indicated by the mean p-value of .35 and a modal score of zero.

The present form of the Numerical Reasoning test consists of 20 items selected from a longer test of 44 items. A freshman form for the test was constructed by choosing 20 items from the 44-item pool according to the criteria of: (a) p-values between .10 and .90, averaging about .50, and (b) item-total correlations of .20 or higher. The item format of the suggested Freshman Numerical Reasoning test is given in Table 34. Thirteen of its 20 items also appear on the original 20-item

Insert Table 34 about here

scale developed for an adult sample (Sung, Note 3). Frequency distributions of item difficulties and discrimination indices for the freshman form are shown in Table 32. The new form demonstrates a mean p-value of .55 and item discrimination functions of .40 or higher.

Recommendations for the Further Development of the Experimental Memory Tests

The four experimental memory tests were evaluated according to the statistical criteria listed in the previous section. This section contains recommendations for the further development of each memory test: Associative Memory, Auditory Memory Span, Visual Memory Span, and Facial Memory. Detailed item analyses for the memory span tests are presented in Appendix C.

Associative Memory

No major revisions are indicated. According to the data presented in Table 13, the 2-minute study period provided more desirable psychometric characteristics than the 1 1/2-minute study period. The longer study period resulted in both a larger range of scores and a higher mean score.

The speededness of the test and trivial difficulty of the test items do not permit a traditional item analysis. However, to ensure that the items are approximately equal in difficulty, as expected, it is recommended that item difficulties be calculated for either the Ball employees or one of the freshman groups. Items displaying markedly deviant p-values should be replaced.

Auditory Memory Span

The Auditory Memory Span test displayed a large range of scores and a high degree of internal consistency reliability (alpha of .90, split-half coefficient of .85). The total credit scoring method was selected over the partial credit method because the former granted more credit to the subjects responding correctly to the more difficult items. (The total and partial credit scoring methods are described in Appendix A.) However, several significant problems were evident: a surplus of very difficult items, an overly lengthy test administration time (ten minutes), and cheating among test-takers.

The inappropriate difficulty of the test for freshmen was indicated by a mean score of 7.25 (of 25 possible points) and a mean item difficulty of .29. Item difficulties were clearly a function of item length: mean p-values ranges from .52 for the shortest items (six digits) to

.18 for the longest items (ten digits). Approximately half of the test (13 items) consisted of difficult nine- and ten-digit items. Item analysis also revealed that the most difficult items also displayed the highest discrimination functions. Nevertheless, all of the items except one demonstrated satisfactory item-total correlations of .20 or greater. The surplus of difficult items is responsible for the overly long test administration time and perhaps to some extent for the cheating. A lengthy and difficult test is probably not conducive to the establishment of rapport between the test-takers and the test administrator. For these reasons, the construction of a shorter test at a more appropriate level of difficulty is recommended for use with freshmen. A suggested format for a 10-item test is presented in Table 35. The items contain

Insert Table 35 about here

between six and eight digits, with item difficulties in the range of .63 to 24. The mean p-value is .41.

A shorter test will almost certainly result in lower internal consistency reliability. However, reduced reliability must be weighed against shorter administration time and greater cooperativeness among the test-takers. The use of the shorter test format would probably lessen the cheating problem as well.

Finally, it is recommended that data be collected on adult samples. The suggested test format is based solely upon freshman data and may not be appropriate for use with adults.

Visual Memory Span

The Visual Memory Span test displayed a wide range of symmetrically distributed total scores. A mean score of 17.01 (of 24 possible points)

and mean item difficulty of .71 indicated that most test-takers found the test to be relatively easy. Items consisting of three, four, or five digits were very easy, as indicated by their p-values of .99, .99, and .97, respectively. Again, item difficulty was correlated with item discrimination such that the most difficult items showed the most discriminative power. The shorter items of three to five digits displayed uniformly low item-total correlations of .20 or less.

The two reliability estimates, coefficient alpha and the split-half coefficient, yielded disparate but not inexplicable results. A value of .81 was obtained using the formula for the alpha coefficient. The low (.45) estimate provided by the split-half method may be an artifact of the method itself, in which test items are divided in half and scores on the two half-tests are correlated. One of the difficulties with the split-half method is that the correlation between halves varies somewhat depending on how the items are divided. The criteria used for the division of items by the SPSS subprogram RELIABILITY are not specified; presumably some groupings would result in higher values than others.

A suggested new format for the Visual Memory Span test is presented in Table 36. The new format resembles the old in the approximate number

Insert Table 36 about here

of items (25) and the use of several unscored warmup items. However, several changes have been made. A two-slide example sequences have been added to orient test-takers to the pace of the slide changes. Items containing five or fewer digits have been eliminated, and more items of seven or more digits have been added. Thus the number of items is

roughly the same, but the average item difficulty has been increased to approximately .50. The addition of more difficult, and presumably more cohesive, items will also raise the estimates of reliability.

The proposed format is still rather lengthy with 25 items. However, the rapid rate of presentation appears to minimize test-takers' fatigue and tedium. occasional cheating was apparent, but it seemed to occur less frequently than for the Auditory Memory Span test.

The technical aspects of test administration presented some difficult problems. The necessary equipment (slide projector and screen) were cumbersone and heavy, and many testing rooms were not furnished with shades to block out sunlight. Some test groups were too large to allow adequate viewing for all present. Finally, test administration required a test administrator to advance the slides manually with the use of a stopwatch, a procedure clearly subject to human error. The present arrangement also effectively prevents the test administrator from proctoring the test.

One solution to the above-mentioned technical problems would be the purchase of a large-screen slide viewer which automatically advances the slides at present intervals. The slide viewer would provide a more standardized presentation to each group of test-takers. However, the screen is too small for use with a group of 10 or more subjects.

The above recommendations are based solely on data from the freshman study. Adult data are also needed for further test development.

Facial Memory

The analyses of both forms of the Facial Memory test yielded results both promising and problematical. Some of the concerns to be discussed in this section are: (a) the failure of many test-takers to make

the correct number of responses according to the instructions (seven or nine, depending upon which form was used), (b) the low estimates of internal consistency reliability, and (c) a comparison of the psychometric properties of the two forms.

The test instructions ask the subjects to choose exactly seven or nine faces (depending on the test form) during the immediate and delayed recognition tests. According to Table 15, between 16 and 72 percent of all test-takers did not make the correct number of responses. Since only the subjects making the correct number of choices were used in subsequent analyses of the Facial Memory data, sample sizes were significantly reduced. Table 15 also shows that subjects selecting exactly seven or nine faces achieved somewhat higher scores than the total sample.

Two possible solutions are suggested: (a) clarify the test instructions, or (b) allow more response time. The test instructions should be reworded in a way that more clearly conveys the importance of the task to be undertaken. It is also recommended that the response time be extended by 30 seconds to allow subjects sufficient time to scan the test and respond as directed.

The second concern involves the low reliability estimates obtained for both test forms as shown in Table 13. Reliabilities were calculated only for the immediate recognition test of each form. Three possible explanations will be discussed: (a) the few items (seven or nine) composing each test, (b) the speededness of the test, and (c) the possibility that some other method might be more appropriate than the internal consistency methods for estimating test reliability.

First, it is relatively difficult to construct a highly reliable test of fewer than 10 items under any circumstances. According to a well-known principle of test construction, tests can be made more reliable by making them longer (Nunnally, 1967). However, the constraints of administration time and available test material advise against constructing a longer test.

A second explanation for low test reliability is the speeded nature of the tests. Though the Facial Memory tests are not speeded tests in their purest form, the restrictive time limits may not allow adequate time for response, with the consequence of lowered average inter-item correlations. According to Nunnally, the reliability of speeded tests cannot be based on internal consistency methods.

The speededness issue leads directly to the third proposed explanation: it may be that other methods are more appropriate for estimating reliability than internal consistency methods. The novelty of the Facial Memory test may disqualify the use of methods employed to analyze more traditional tests. The test items were purposely selected to produce probe faces and distractor faces of varying degrees of similarity. For example, a choice between two faces identical except for the eyes may present an entirely different problem than faces differing in other respects. Thus internal consistency methods based on the average correlation among items may not provide a suitable estimate of test reliability.

Two methods will be discussed as possible alternatives to the use of coefficient alpha and the split-half method. Nunnally (1967) suggests the use of the alternate form method for speeded tests. Rather

than a single 9-item test, for example, one would construct two 9-item tests. The correlation between the scores on the two tests provides an estimate of alternate-forms reliability.

Another option is the test-retest method, in which the same test is given to the same people after a period of time. An approximation of test-retest reliability was obtained by correlating scores on the immediate and delayed tests for each form. The immediate and delayed tests, although containing the same probe faces, cannot be considered as a true test-retest situation, however. The probe faces are arranged in different positions on the page, and different distractor faces were used. Correlations between the immediate and delayed recognition tests for the two forms were .50 and .51, considerably higher than the internal consistency estimates.

The choice of reliability analysis is difficult. If internal consistency methods are inappropriate, other methods should be considered and implemented, if possible. The strengths and weaknesses of the alternate-form and test-retest methods are discussed fully by Nunnally (1967). For example, one can never be certain that so-called alternate forms are comparable in every respect. The weakness of the test-retest method is that experience in the first testing will influence responses in the second testing.

The third concern regarding the Facial Memory test involves the comparison of the two test forms in terms of their psychometric qualities. The data presented in Tables 15 and 16 do not provide a strong case for the superiority of one form or the other. The two forms showed similar reliabilities, item difficulties, and standard deviations. They

also displayed a similar decay in facial memory between the immediate and delayed tests of recognition.

If, however, a choice was to be made between the two, it appears that the longer form has somewhat more potential for further development. The longer form consistently displays a larger standard deviation. A longer test also enchances the possibility of increased test reliability. Furthermore, more test items provide additional material for more elaborate analyses. For example, Appendix A contains detailed information about the composition of each face, and which features are shared by the study faces and distractor faces. This information would allow analyses to determine the salience of the various facial features, e.g., whether hairstyle provides a stronger cue than chin size for facial recognition. However, the large scale of the proposed analysis may render it a topic for a separate paper.

Finally, it should be noted that the appearance and clarity of the pictures suffers somewhat from the method of photocopying used to reproduce the test. The quality of reproduction will be greatly improved by the use of the photographic negatives.

All Memory Tests

Table 17, "Correlations Between BAB Tests and Experimental Tests," should be completed. Inter-correlations among the four memory tests should also be computed. The inter-correlation table will necessarily remain incomplete, however, because most subjects were administered only one or two experimental tests.

Recommendations for Future Research

This section contains recommendations for future research in the following three areas: (a) examination of the concurrent validity of the BAB for freshmen, (b) development of a socioeconomic status (SES) index, and (c) further investigation of the differentiation hypothesis using both a cross-sectional design (comparison of freshmen and seniors) and a longitudinal design (follow-up of freshmen during their senior year).

Concurrent Validation Study

The emphasis of the present report has been on the internal properties of the BAB: item characteristics, test reliability, and factor structure. The further development of the BAB requires investigations of the battery's practical or criterion-related validity for freshmen.

A concurrent validation study of 500 high school seniors was reported by Dohm and Sung (Note 1). Course grades and overall grade-point average (GPA) were obtained from academic transcripts and correlated with BAB test scores. In general, the GPA criterion was predicted best, followed by English and Social Stuides grades. The Vocabulary test was the single best predictor across all criteria, followed by Analytical Reasoning, Ideaphoria, and Clerical. Next, a series of stepwise multiple regression analyses were undertaken using combinations of BAB tests to predict course grades and GPA. The highest multiple R (.536) was obtained when predicting GPA from Vocabulary, Clerical, Ideaphoria, and Paper Folding.

A similar study using academic criteria would serve to establish the concurrent validity of the BAB for the freshman sample.

SES Index

Moderately large race-group differences are observed on the Paper Folding, Vocabulary, Ideaphoria, Analytical Reasoning, Numerical Ability, and Numerical Reasoning tests, as shown in Table 18. However, these findings should be interpreted in the context of the fact that SES and other relevant covariates were not controlled, either in the sampling procedure or by statistical means. The confounding of race and SES variables has been noted by a number of researchers (Tyler, 1965; Sung & Dawis, 1981).

The development of an SES index for the study of high school seniors was described by Dohm and Sung (Note 1). In addition to the test data, information was gathered regarding number of household items and parental education, occupation, and income. A factor analysis of these SES indicators yielded one large factor accounting for 50 percent of the total variance. The father's occupational level contributed most to the explanation of factor variance, followed by father's educational level, parental income, and number of household items. Three SES classes were established: lower, middle, and upper. Approximately one-third of the subjects were assigned to each SES group on the basis of their factor scores.

The resulting distribution showed that the black and hispanic groups were over-represented in the lower-third SES category, and the white group was over-represented in the upper-third category. Despite the confounding of the race and SES variables, the factor structure of the BAB was highly similar across race groups. SES was also used as the covariate in alalyses of covariance, with race and sex as independent

variables and each BAB test as the dependent variable to estimate the relative contributions of race and sex to the explained variance of each test.

The development of an SES index for the freshman sample would allow for similar analyses and provide further information about the distribution of SES within the group. Biographical inventories filled out at the time of testing provide the necessary SES indicators. After factor analysis and the calculation of factor scores, the assignment of each subject to one of the three SES classes would permit a parallel series of analyses of covariance.

The development of an SES index has implications for the further investigation of the differentiation hypothesis as well. The comparability of the freshman and senior samples could be further assessed in terms of the proportions of each racial group assigned to a particular SES class. Similar distributions of race and sex would result in increased confidence that the two groups could be compared in a cross-sectional design.

Differentiation Hypothesis

The fifth purpose of the present study was to investigate the hypothesis that abilities differentiated with age, from an amorphous general ability in early childhood to increasingly distinct and specialized abilities by late adolescence. A cross-sectional study was proposed to compare the BAB for factor structures for the high school freshmen and for the seniors (Sung & Dawis, 1981). Factor analyses of the senior data yielded between 10 and 12 well-defined factors replicated across race and sex groups. The factor analytic results for freshman group

were less clear-cut. Patterns of 7 to 12 factors emerged for the race groups, similar in structure to the pattern observed for the senior groups. However, analyses of the total group and both sex groups produced only 5 factors, including a large general factor.

No conclusions about the support or lack of support of the differentiation hypothesis can be made on the basis of these data. First, the inconsistent results for the freshman groups leave in doubt the number of factors for that group. The factor-analytic results for the larger groups (total, males, and females), however, appear to provide some support for the hypothesis. The reason for the disparate findings between the sex and race groups is not clear. Second, the comparisons of BAB factor structure for the two age groups are not based on the same group of BAB tests. Both age groups were administered the following 14 tests: Clerical, Idea Fluency, Inductive Reasoning, Word Association, Writing Speed, Paper Folding, Vocabulary, Ideaphoria, Finger Dexterity (Left and Right), Grip (Left and Right), Shape Assembly, and Analytical Reasoning. In addition, three music tests were given only to the seniors, and two numerical tests given only to the freshmen. The differences in the composition of the test battery, and subsequent differences in the inter-test correlations, may have contributed to the inconclusive findings as well.

To provide a clear-cut test of the differentiation hypothesis, factor analyses should include only the 14 test variables held in common by the two age groups. Coefficients of factor congruence should also be recalculated based on the results of the reanalysis. Statistical criteria for the demonstration of age-differentiation, including increasing number of factors, are given by Garrett (1946).

The proposed cross-sectional comparison, the proposed reanalysis notwithstanding, leaves open the possibility that differences in factor structure are due to sampling or other factors beside age differences. The proposed longitudinal study of the freshman sample through their senior year of high school will provide an even more powerful test of the age-differentiation hypothesis.

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FOOTNOTE

[1]Early researchers (Burt, 1954; Garrett, 1946) attributed the differentiation of abilities to mental and physical maturation. The proposed longitudinal study would yield results bearing on the maturation hypothesis. A biographical inventory filled out by subjects on both testing occasions will permit the assessment of the importance of a number of factors which may influence the differentiation of abilities.

Table 1

Distribution of Subjects by Race and Sex

	Race				
Sex	Black	White	Hispanic	Oriental	Total
Male	54	147	21	1	223
Female	73	128	21	0	222
Total	127	275	42	1	445

Table 2

Summary Characteristics of the Ball Aptitude Battery (BAB) Tests[a]

BAB test	No. of Items	Work time (min.)	Reliability[b]			Standard error of measurement
			Total	Male	Female	
Clerical	240	5.00	.89	.89	.91	7.23
Idea F.	4	8.00	.73	.80	.65	5.38
Induct. R.	30	8.00	.71	.71	.71	2.07
Word A.	100	8.00	.64	.82	.51	4.74
Writing S.	NA	1.00	.69	.63	.77	19.15
Paper F.	24	10.00	.85	.84	.85	1.94
Vocabulary	80	22.00	.98	.97	.98	2.65
Ideaphoria	NA	10.00	.79	.77	.79	31.84
Finger Dex.[c]	NA	3.00	.79	.78	.79	4.40
Grip[c]	NA	3.00	.93	.91	.93	19.71
Shape A.	6	15-35.00	.70	.73	.65	4.12
Analyt. R.	18	12.25	.73	.74	.72	8.25

[a]From Sung and Dawis (1981, p. 615)

[b]The reliability study sample was a heterogeneous group of 261 individuals from high schools, colleges, and the general population. With the exception of Vocabulary, test reliabilities were estimated using the test-retest method with an interval of six weeks between the test and retest. The reliability of the Vocabulary test was assessed by the alternate-form method.

[c]Total score (i.e., left hand score plus right hand score).

Table 3

Summary Characteristics of the Numerical Tests

Test	No. of Items	Work time (min.)	Reliability	Standard error of measurement
Numerical Ability	20	13	.90[a]	1.75
Numerical Reasoning	20	20	.78[b]	2.35

Note. The reliability study sample consisted of 209 high school and trade school students.

[a]Cronbach's coefficient alpha.

[b]Split-half coefficient with Spearman-Brown correction.

Table 4

Frequency Distributions of Item Difficulty and Item Discrimination Indices by BAB Test

	Induct. R.		Vocab.		Paper F.		Shape A.		Analyt. R.	
Index[a]	Diff.	Disc.	Diff.	Disc.	Diff.	Disc.	Diff.	Disc.	Diff.	Disc.
.90-.99	7	-	-	-	-	-	-	-	-	-
.80-.89	2	-	3	-	-	-	3	-	-	-
.70-.79	5	-	2	-	1	-	-	-	1	-
.60-.69	7	-	2	1	1	-	2	-	2	-
.50-.59	4	-	6	6	3	1	1	-	2	1
.40-.49	3	-	12	15	6	10	-	2	5	4
.30-.39	2	1	11	24	5	5	-	1	2	9
.20-.29	-	9	25	22	4	3	-	3	4	2
.10-.19	-	18	17	9	4	3	-	-	1	1
.00-.09	-	1	2	2	-	2	-	-	-	1
Below .00	-	1	-	1	-	-	-	-	-	-

[a]Item difficulty is the proportion passing the item; item discrimination is r_{pbis} between item and total score.

Table 5

Frequency Distributions of Item Difficulties and Item Discrimination Indices for Numerical Tests

Index[a]	Num. I (Full Scale)		Num. I (Washburne Scale)		Num. II (Full Scale)		Num. II (Washburne Scale)	
	Diff.	Disc.	Diff.	Disc.	Diff.	Disc.	Diff.	Disc.
.90-.99	3	-	-	-	2	-	-	-
.80-.89	2	-	-	-	4	-	-	-
.70-.79	5	-	1	-	3	-	-	-
.60-.69	1	8	2	8	6	9	3	5
.50-.59	6	12	6	6	4	17	2	12
.40-.49	5	6	4	5	5	9	4	1
.30-.39	3	5	3	-	3	6	3	2
.20-.29	6	5	4	1	5	2	3	-
.10-.19	3	4	-	-	6	-	3	-
.00-.09	5	-	-	-	5	-	2	-
Below .00	-	-	-	-	-	-	-	-

[a]Item difficulty is the proportion passing the item; item discrimination is r_{pbis} between item and total score.

Table 6

Reliability Coefficients of Selected BAB Tests for Total Sample and Separate Sex Groups

BAB Test	Reliability						Standard Error of Measurement[a]
	Total		Male		Female		
	Alpha	Split-Half	Alpha	Split-Half	Alpha	Split-Half	
Induct. R.	.62	.59	.57	.53	.65	.63	2.27
Paper F.	.80	.70	.78	.67	.80	.72	2.10
Vocabulary	.91	.82	.90	.86	.91	-	3.71
Num. I							
Full Scale	.92	.80	.91	.79	.92	.81	2.31
Washburne	.91	.85	.90	.85	.91	.85	1.73
Num. II							
Full Scale	.94	.79	.94	.77	.94	.80	2.37
Washburne	.91	.82	.91	.81	.91	.82	1.62
Shape Assembly	.60	.57	.55	.54	.62	.58	4.49
Analytical R.	.77	.71	.73	.69	.79	.73	7.88

Note. N's = 445 for total group; 223 males; and 222 females.

[a]Calculated according to the formula: $SEM_x = sd_x(1-r_{xx})$.

Table 7

Numbers for Item Comprising Short Scales
of Numerical Ability and Numerical Reasoning Tests

Numerical Ability	Numerical Reasoning
4	9
11	10
12	15
13	18
14	20
15	21
16	22
17	23
18	24
19	25
20	26
21	27
22	28
23	29
24	31
25	32
26	33
27	34
30	35
31	36

Table 8

Intercorrelations Among The Numerical Tests (N=443)

Test	(1)	(2)	(3)	(4)	Total Mean	Total SD
1. Numerical I (Full Scale)	-				17.76	8.11
2. Numerical I (Washburne Scale)	.97	-			9.16	5.76
3. Numerical II (Full Scale)	.76	.75	-		19.02	9.69
4. Numerical II (Washburne Scale)	.75	.74	.96	-	6.99	5.39

Note. Number of items per scale is 40 for Numerical I-Full Scale, 20 for Numerical I-Washburne Scale, 43 for Numerical II-Full Scale, and 20 for Numerical II-Washburne Scale.

Table 9

Means and Standard Deviations for High School Freshmen and Seniors by BAB Test

BAB Test	Freshmen (N=445)		Seniors (N=1009)	
	Mean	SD	Mean	SD
Clerical	177.78	24.01	188.9	19.5
Idea F.	20.64	8.37	26.6	9.9
Induct. R.	20.84	3.66	22.4	3.6
Word A.	23.57	8.36	25.6	7.5
Writing S.	138.75	39.48	145.1	30.7
Paper F.	9.18	4.67	10.8	5.1
Vocabulary	26.32	12.37	36.7	16.2
Ideaphoria	126.22	65.63	158.9	73.5
FD-L.	35.59	4.83	40.9	5.6
FD-R.	39.41	5.11	46.1	6.1
Grip-L.	99.88	26.07	110.4	34.9
Grip-R.	108.62	26.92	121.5	37.3
Shape A.	15.16	7.09	14.9	7.5
Analyt. R.	28.54	16.42	32.3	16.1
Num. I	9.16	5.76	-	-
Num. II	6.99	5.39	-	-

Table 10

Interim Norms for Freshman Females

% ile	CLER	IP	IR	WA	WS	PF	V	IP	% ile
99	236+	42+	28+	41+	300+	20+	61+	265+	99
98	235	41-42	27	40	297-299	19	57-60	262-264	98
97	233-234	39-40		39	260-296	18	53-56	256-261	97
96	231-232	37		38	215-259	17	52	251-255	96
95	225-230	36	26	37	210-214	16	49-51	248-250	95
94	221-224				193-209	15	48	245-247	94
93	217-220	35		36	189-192			240-244	93
92	216	33-34	25		188		47	234-239	92
91	213-215				186-187		46	228-233	91
90	211-212	32			178-185		45	226-227	90
89	209-210	31		35	175-177		42-43	223-225	89
88		30			170-174	14	41	218-222	88
87	208			34				215-217	87
86	206-207			33			40	209-214	86
85	204	29	24		169	13	39	205-208	85
84	203	28		32			38	203-204	84
83					168			200-202	83
82	202				167		37	199	82
81	201	27			166		36	198	81
80				31	164-165	12		196-197	80
79	200				162-163		35	194-195	79
78	199							193	78
77	198							189-192	77
76		26			161		34	188	76
75	197			30				187	75

Table 10 (Continued)

% ile	CLER	IF	IR	WA	WS	PF	V	IP	% ile
74	196				160		33	186	74
73	195	25	23	29		11	32	185	73
72	194				159		31	183-184	72
71		24					30		71
70				28	158			182	70
69						10	29	178-181	69
68	193							175-177	68
67					157			174	67
66	192	23			156			172-173	66
65					154-155			170-171	65
64	191			27	153		28	167-169	64
63	190				152			165-166	63
62	189	22			150-151		27	161-164	62
61	188		22			9		160	61
60	187			26				156-159	60
59					149				59
58	186						26	155	58
57	185	21			148			150-154	57
56							25	147-149	56
55				25	147	8		146	55
54	183-184				145-146			145	54
53					143-144			143-144	53
52				24			24	141-142	52
51	182	20						140	51
50	181		21			7		138-139	50
49								135-137	49

Table 10 (Continued)

% ile	CLER	IF	IR	WA	WS	PF	V	IP	% ile
48	180				142		23	133-134	48
47	179				141			132	47
46		19		23	139-140			130-131	46
45					138		22	127-129	45
44	178				137			124-126	44
43			20	22	135-136			123	43
42							21	122	42
41						6		118-121	41
40	177	18		21				115-117	40
39								112-116	39
38	176						20	109-111	38
37	175						19	106-108	37
36		17		20				103-105	36
35	174							100-102	35
34			19					98-99	34
33		16		19				96-97	33
32							18	94-95	32
31	173							93	31
30				18	133-134		17	92	30
29	172				131-132	5		90-91	29
28	171				130			88-89	28
27	170	15						86-87	27
26	169		18	17				84-85	26
25	168				129			83	25
24		14					16	79-82	24
23					127-128	4		77-78	23

Table 10 (Continued)

% ile	CLER	IF	IR	WA	WS	PF	V	IP	% ile
22	167			16	125-126				22
21					124			75-76	21
20	165-166	13			123		15	72-74	20
19				15				70-71	19
18	164	11-12						69	18
17	163		17						17
16	162			14	121-122	3	14	68	16
15	161				116-120			67	15
14	160	10		13				65-66	14
13			16		115		13	62-64	13
12	159	9		12	114			59-61	12
11			15				12	55-58	11
10	158	8		11	111-113			51-54	10
9	157				107-110			50	9
8	155-156					2	11	47-49	8
7	153-154		14	10				42-46	7
6	151-152		13		106		10	37-41	6
5	147-150	7		9			9	34-36	5
4	144-146		12	8	96-105	1		32-33	4
3	136-143	6		7				28-31	3
2	133-135	3-5	11		89-95		8	22-27	2
1	132-	0-2	10-	6-	88-		0-7	21-	1
N	193	194	195	195	192	194	195	195	
$\bar{X}$	183.70	20.64	20.82	23.80	151.70	8.40	26.26	138.56	
SD	22.43	8.82	3.90	8.70	51.64	4.67	12.80	65.08	

Table 10 (Continued)

% ile	FL	FR	GL	GR	Num. I (Washburne)	Num. II (Washburne)	% ile
99	47+	49+	128+	138+	20	19-20	99
98	46		120-127	135-137	19		98
97		48	118-119	134		18	97
96	45		116-117	128-133	18	17	96
95	44		109-115	123-127		16	95
94		47	107-108	121-122			94
93			106	120			93
92	43			119		15	92
91			105	116-118	17		91
90		46	104	115		14	90
89			103	114			89
88	42		102	112-113			88
87		45	101	111		13	87
86	41		100	109-110			86
85	40		99	108			85
84			98	107			84
83				106	16		83
82		44				12	82
81			97				81
80			96				80
79				105		11	79
78			95				78
77				104	15	10	77
76	39						76
75			94		14		75

Table 10 (Continued)

% ile	FL	FR	GL	GR	Num. I (Washburne)	Num. II (Washburne)	% ile
74				102-103			74
73						9	73
72		43	93				72
71			92				71
70				101			70
69							69
68							68
67	38			100	13		67
66		42	91	99		8	66
65			90				65
64							64
63				98			63
62	37		89			7	62
61				97	12		61
60			88				60
59		41					59
58			87	96	11		58
57							57
56	36						56
55					10		55
54			86			6	54
53				95			53
52			85				52
51				94	9		51
50			84				50

Table 10 (Continued)

% ile	FL	FR	GL	GR	Num. I (Washburne)	Num. II (Washburne)	% ile
49						5	49
48		40					48
47				93			47
46				92	8		46
45	35						45
44			83				44
43			82	91			43
42				90		4	42
41			81		7		41
40			80				40
39		39	79	89			39
38	34					3	38
37			78	88			37
36					6		36
35							35
34				87			34
33		38					33
32	33			86		2	32
31							31
30			77		5		30
29							29
28		37	76	85			28
27				84			27
26						1	26
25			75	83			25

Table 10 (Continued)

% ile	FL	FR	GL	GR	Num. I (Washburne)	Num. II (Washburne)	% ile
24	32		74	82			24
23		36		81	4		23
22							22
21			73	80			21
20			72				20
19				78-79	3		19
18		35	71				18
17	31			77			17
16			70	75-76	2		16
15			69	74			15
14	30		68				14
13					1		13
12		34		73			12
11	29		66-67	72			11
10		33					10
9			64-65	70-71		0	9
8			62-63	69			8
7	28	32		68			7
6		31	60-61		0		6
5			59	67			5
4	27		58	64-66			4
3	26	30	56-57	63			3
2	24-25	27-29	52-55	60-62			2
1	23-	26-	51-	55-			1
N	180	180	179	180	194	194	
$\overline{X}$	36.04	40.17	85.22	94.09	9.69	6.54	
SD	5.14	5.16	15.72	17.50			

Table 11

Interim Norms for Freshman Males

% ile	CLER	IF	IR	WA	WS	PF	V	IP	% ile
99	225+	42+	27+	38+	210+	22+	61+	289+	99
98	220-224	40-41			197-209	20-21	57-60	276-288	98
97	217-219	39			195-196	19	56	269-275	97
96	214-216	37-38		36-37	193-194	18	55	257-268	96
95	213	35-36	26		189-192		53-54	246-256	95
94	210-212			35	187-188	17	50-52	231-245	94
93	209			34	185-186		48-49	227-230	93
92	205-208	34			183-184		46-47	220-226	92
91	204				181-182		45	218-219	91
90	201-203	32		33	179-180		43-44	213-217	90
89	200		25		177-178		42	211-212	89
88	198-199				175-176	16		206-210	88
87	197			32	173-174		41	109-205	87
86					172		40	197-198	86
85		31		31	170-171	15	39	195-196	85
84	196				166-169			193-194	84
83	195	30		30	163-165		38	191-192	83
82	193-194				162			188-190	82
81	192	29	24		161			182-187	81
80							37	178-181	80
79		28			160	14	36	175-177	79
78	191							168-174	78
77		27		29	159			165-167	77
76	190						35	164	76
75	188-189				158			163	75

Table 11 (Continued)

% ile	CLER	IF	IR	WA	WS	PF	V	IP	% ile
74	187		23						74
73	186				157			155-162	73
72	185				154-156	13	34	153-154	72
71	184			28	153			151-152	71
70		26			151-152		33		70
69	183				150			150	69
68					149	12		148-149	68
67					148		32	147	67
66	182	25		27	147			143-146	66
65	181				146		31	138-142	65
64					145			136-137	64
63	180		22	26	143-144			131-135	63
62					142			130	62
61							30		61
60					141	11	29	129	60
59	179	24			139-140			126-128	59
58				25					58
57	178				138		28	125	57
56					137			124	56
55					136			122-123	55
54		23			135		27	120-121	54
53				24				118-119	53
52	177							117	52
51			21		134			110-116	51
50	176	22					26	107-109	50
49				23				106	49

Table 11 (Continued)

% ile	CLER	IF	IR	WA	WS	PF	V	IP	% ile
48	175				133	10	25	103-105	48
47								101-102.	47
46		21					24	99-100	46
45	174			22				95-98	45
44					132			94	44
43	173						23	90-93	43
42		20		21		9			42
41	172				131			89	41
40	171	19					22	85-88	40
39	170		20					84	39
38	169							82-83	38
37				20	125-130			81	37
36	168	18					21	79-80	36
35					123-124			74-78	35
34							20	73	34
33	166								33
32	165	17		19		8		72	32
31	164				122				31
30							19	71	30
29	163		19					70	29
28				18	120-121	7	18		28
27	162	16			119			67-69	27
26	161				116-118		17	63-66	26
25	160				115	6			25
24	158-159							62	24
23		15		17	114				23

Table 11 (Continued)

% ile	CLER	IF	IR	WA	WS	PF	V	IP	% ile
22					112-113		16	60-61	22
21					110-111			58-59	21
20	157		18	16	108-109	5		57	20
19								56	19
18	156	14		15				55	18
17					107			54	17
16	155						15	49-53	16
15								44-48	15
14	154	13	17		106			42-43	14
13	153			14	103-105	4		41	13
12	152	11-12			99-102			39-40	12
11				13	97-98	3	14	34-38	11
10	149-151	10		12				28-33	10
9	148				96			27	9
8	147			11	89-95		13	23-26	8
7	146	9			82-88			22	7
6	138-139	8	16	10	81		12	21	6
5	136-137				78-80		11	19-20	5
4	134-135	7	15		69-77			13-18	4
3	131-133	4-6	14	9	62-68	2	10	11-12	3
2	110-130		13	7-8	57-61	1	9	10	2
1	109-	0-3	12-	6-	56-		0-8	0-9	1
N	157	155	157	158	158	158	158	157	
$\bar{X}$	175.17	22.15	21.29	23.40	137.23	10.42	27.89	118.82	
SD	22.50	8.62	3.35	7.78	34.11	4.84	12.52	70.49	

Table 11 (Continued)

% ile	FL	FR	GL	GR	Num. I (Washburne)	Num. II (Washburne)	% ile
99	45+	51+	178+	176+	19+	20	99
98	44	50	172-177	175			98
97		49	165-171	174		19	97
96		48	157-164	172-173	18	17-18	96
95	43	47	156	170-171			95
94			154-155	168-169			94
93		46	152-153	167			93
92						16	92
91	42		151	166			91
90			147-150	165	17		90
89				164		15	89
88	41	45	146	163			88
87				161-162			87
86			145	157-160			86
85	40		143-144				85
84		44	140-142	155-156	16	14	84
83				154			83
82				152-153			82
81			139		15		81
80		43	138	150-151			80
79			137				79
78			136	148-149		13	78
77				146-147	14		77
76	39		135	145		12	76
75				144			75

Table 11 (Continued)

% ile	FL	FR	GL	GR	Num. I (Washburne)	Num. II (Washburne)	% ile
74		42	134				74
73				143	13		73
72						11	72
71	38		132-133	142			71
70			131	140-141			70
69			129-130	138-139			69
68			128		12		68
67							67
66		41	127	136-137			66
65							65
64			126	134-135		10	64
63			124-125				63
62				133			62
61	37		123	132			61
60			122	130-131			60
59				129	11	9	59
58			120-121	128			58
57							57
56		40		126-127			56
55			119				55
54			118	125			54
53							53
52	36		116-117	124			52
51				123			51
50			115		10	8	50

Table 11 (Continued)

% ile	FL	FR	CL	GR	Num. I (Washburne)	Num. II (Washburne)	% ile
49			114	122			49
48			113				48
47		39	112	121			47
46							46
45	35		111	120	9	7	45
44			110				44
43			109				43
42						6	42
41			108		8		41
40		38		119			40
39			107	118			39
38				117			38
37			105-106	116			37
36	34			115	7		36
35							35
34			104	114	6	5	34
33							33
32				113			32
31		37	103				31
30				112			30
29			102	111	5	4	29
28							28
27				110			27
26	33		101				26
25				109	4		25

Table 11 (Continued)

% ile	FL	FR	GL	GR	Num. I (Washburne)	Num. II (Washburne)	% ile
24			100	108			24
23			99	107			23
22			98		3	3	22
21		36	96-97				21
20	32		95	106			20
19				105			19
18			94	104			18
17			93	103	2	2	17
16			92			1	16
15		35	91	102			15
14	31			100-101			14
13			90	99			13
12			89	98			12
11		34	88	97	1		11
10	30	33	86-87	96		0	10
9				95			9
8		32	85				8
7	29		83-84	94			7
6		31		92-93			6
5			80-82	88-91			5
4			78-79	85-87	0		4
3	28		76-77	83-84			3
2	27	30	70-75	82			2
1	26-	29-	69-	81-			1
N	147	146	147	146	157	157	
$\overline{X}$	36.20	39.84	117.70	127.55	9.52	8.31	
SD	4.34	4.80	24.65	25.01			

Table 12

Frequency Distributions of Item Difficulties and Discrimination Indices for Memory Span Tests

Index[a]	Auditory Memory Span		Visual Memory Span	
	Diff.	Disc.	Diff.	Disc.
.90 - .99	-	-	10	-
.80 - .89	-	-	2	-
.70 - .79	-	1	1	-
.60 - .69	1	6	2	2
.50 - .59	1	7	1	3
.40 - .49	5	8	2	3
.30 - .39	2	1	5	4
.20 - .29	9	1	1	2
.10 - .19	7	1	-	2
.00 - .09	-	-	-	6
Below .00	-	-	-	2

[a]Item difficulty is the proportion passing the item; item discrimination is r_{pbis} between item and total score.

Table 13

Reliability Coefficients for Experimental Tests

Test	N	Reliability	
		Alpha	Split-Half
Research Vocabulary	231	.95	.88
Visual Memory Span	162	.81	.45
Auditory Memory Span	98	.91	.85
Facial Memory:			
7/18 Form: Imm. Del.	73[a]	.25	.29
9/23 Form: Imm. Del.	45[b]	.22	.06

[a]The analysis included only those protocols with exactly seven responses on both recognition tests.

[b]The analysis included only those protocols with exactly nine responses on both recognition tests.

Table 14

Associative Meory Test Means and Standard Deviations for Different Groups

Group	Length of Study Period							
	1-1/2 min.				2 min.			
	N	Mean	SD	Range	N	Mean	SD	Range
High School Freshman								
School 426	13	4.85	2.88	1,9	76	5.80	2.87	1,13
School 427	-	-	-	-	53	5.30	2.89	0,13
School 428	-	-	-	-	37	6.11	2.49	2,13
Combined Group	-	-	-	-	168	5.66	2.82	0,13
Longitudinal Follow-up Subjects	-	-	-	-	3	5.67	1.15	5,7
Community Clients	-	-	-	-	6	4.17	2.32	1,8
Ball Employees	-	-	-	-	25	5.04	4.07	0,13

Note. 13 possible points.

Table 15

Descriptive Statistics for Facial Memory Tests for Both Forms

Form	Time of Testing	$0 < x^a < 00$ N	Mean No. of Choices $\bar{X}$	SD	$x = 7,9$ N	$\bar{X}$	SD	r (immed/ delayed)
7/18[b]	Immediate	115	6.84	4.46	1.36	73	4.60	1.37
	Delayed	113	6.95	4.27	1.45	95	4.32	1.44
9/23[c]	Immediate	162	7.99	5.02	1.75	45	5.71	1.56
	Delayed	162	8.75	4.91	1.79	101	5.18	1.77

[a] x represents the number of choices made by the subject.

[b] 7 possible points.

[c] 9 possible points.

Table 16

Means and Standard Deviations for Facial Memory Test by Race and Sex Groups[a]

Form of Test	Time of Testing	Race						Sex					
		Black			White			Male			Female		
		N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
7/18[b]	Immediate	40	4.30	1.32	20	5.15	1.27	19	4.84	1.34	49	4.57	1.41
	Delayed	40	3.85	1.33	20	5.10	1.29	19	4.53	4.53	49	4.31	1.49
9/23[c]	Immediate	6	4.33	1.37	31	5.90	1.56	14	5.50	1.40	23	5.74	1.76
	Delayed	6	4.00	1.90	31	5.61	1.84	14	4.64	1.74	23	5.78	1.93

[a]Only subjects choosing exactly 7 faces in the 7/18 form or exactly 9 faces in the 9/23 form were included in the analyses.

[b]7 possible points.

[c]9 possible points.

Table 17

Correlations Between BAB Tests and Selected Experimental Tests

BAB Test	Experimental Tests: Research Vocabulary (N=233)	Associative Memory (N=168)	Facial Meory (7/18) Immediate (N=66)	Facial Meory (7/18) Delayed (N=66)
Clerical	.22	.13	.22	.15
Idea Fluency	.58	-.01	.39	.26
Induct. Reason.	.46	.18	.35	.24
Word A.	.03	-.08	.10	.10
Writing S.	.04	.20	.08	.08
Paper Folding	.64	.04	.17	.27
Vocabulary	.90	.08	.33	.39
Ideaphoria	.50	.03	.36	.38
F.D.-Left	.10	.14	.20	.17
F.D.-Right	.16	.09	.42	.23
Grip-Left	.14	.04	-.11	-.01
Grip-Right	.15	.08	.03	.13
Shape A.	.44	.07	.24	.22
Analyt. Reason.	.70	.01	.51	.52
Num. I	.68	.03	.38	.46
Num. II	.69	.08	.37	.56
Research Voc.	-	.17	.69	.32
Assoc. Memory	.17	-	-	-
Facial Memory:				
Imm.	.69	-	-	.51
Del.	.32	-	.51	-

Table 18

Means and Standard Deviations
for Total Group and Sex and Race Groups, by BAB Test

BAB Test	Total Group (N=445)		Sex Groups				Race Groups					
			Males (N=223)		Females (N=222)		Black (N=127)		White (N=275)		Hispanic (N=42)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Clerical	177.78	24.01	172.62	21.77	182.96	25.07	170.88	26.59	181.00	22.11	177.29	24.40
Idea F.	20.64	8.37	20.57	8.21	20.70	8.54	14.58	6.30	23.90	7.75	16.83	5.90
Induct. R.	20.84	3.66	20.86	3.51	20.81	3.82	19.30	3.71	21.81	3.28	19.02	3.79
Word A.	23.57	8.36	23.07	7.94	24.08	8.75	22.84	7.58	23.86	8.78	23.86	7.92
Writing S.	138.75	39.48	132.57	33.54	143.47	43.92	136.06	57.78	141.58	27.71	127.48	35.32
Paper F.	9.18	4.67	9.85	4.62	8.50	4.62	5.41	2.98	11.05	4.39	8.10	3.04
Vocabulary	26.32	12.37	26.09	12.03	26.55	12.71	16.43	6.61	31.70	12.00	20.86	5.53
Ideaphoria	126.22	65.63	113.27	65.46	139.17	63.34	80.66	44.26	148.56	63.93	115.12	57.43
FD-L.	35.59	4.83	35.35	4.61	35.83	5.05	35.01	5.53	36.06	4.45	34.38	4.75
FD-R.	39.41	5.11	38.86	5.05	39.96	5.13	39.14	4.87	39.95	5.05	36.72	5.46
Grip-L.	99.80	26.07	115.81	23.71	83.64	16.66	100.37	27.09	100.86	26.07	92.58	22.29
Grip-R.	108.62	26.92	124.84	24.14	92.24	18.31	107.74	26.50	110.00	27.64	102.78	23.18
Shape A.	15.16	7.09	17.07	6.80	13.24	6.86	10.25	6.17	17.58	6.37	13.78	5.88
Analyt. R.	28.54	16.42	29.21	15.40	27.86	17.40	14.59	9.85	35.82	14.56	23.85	15.00
Num. I	9.16	5.76	8.61	5.64	9.72	5.84	4.43	3.76	11.64	5.08	7.19	5.18
Num. II	6.99	5.39	7.45	5.39	6.53	5.35	1.98	2.35	9.64	4.81	4.79	3.35

Table 19

BAB Test Intercorrelations for Black Group (Upper Triangle, N=123) and Hispanic Group (Lower Triangle, N=42)

BAB Test	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Black Mean	Black SD
1. Clerical	--	-08	02	06	22	-15	02	-06	09	10	-14	-13	00	09	21	06	170.9	26.6
2. Idea F.	-04	--	33	07	09	16	37	22	02	03	06	02	19	34	16	11	14.6	6.3
3. Induct. R.	17	19	--	17	-08	15	23	17	08	16	06	-02	16	34	29	37	19.3	3.7
4. Word A.	-03	19	07	--	06	-08	-07	03	12	15	-04	-05	12	01	20	06	22.8	7.6
5. Writing S.	53	-08	04	04	--	-08	-12	04	09	03	-24	-25	-05	00	-06	-16	136.1	57.8
6. Paper F.	-23	32	32	26	-04	--	27	12	08	-02	25	15	33	26	10	24	5.4	3.0
7. Vocabulary	09	22	29	05	00	26	--	15	10	04	00	-04	21	54	23	24	16.4	6.6
8. Ideaphoria	-01	45	17	12	01	11	19	--	12	20	-19	-17	10	00	10	00	80.7	44.3
9. FD-L.	-04	20	-05	26	-04	-07	-18	33	--	44	-01	-10	30	04	10	02	35.0	5.5
10. FD-R.	00	-17	-02	03	17	-22	-33	-17	54	--	-13	-14	27	17	14	24	39.1	4.9
11. Grip-L.	-16	25	24	21	-12	37	18	17	15	-13	--	89	12	12	-08	12	100.4	27.1
12. Grip-R.	-11	24	37	11	-05	43	24	07	01	-19	90	--	11	03	-10	10	107.7	26.5
13. Shape A.	-11	25	30	11	-10	54	25	35	27	07	37	30	--	25	13	25	13.2	6.9
14. Analyt. R.	04	32	51	16	-09	29	35	34	14	-14	21	29	55	--	17	26	27.9	17.4
15. Num. I	20	42	50	29	-09	26	42	53	28	-15	11	12	26	53	--	38	9.7	5.8
16. Num. II	13	29	48	10	-20	36	49	25	-03	-27	18	23	28	27	61	--	6.5	5.4
Hispanic:																		
Mean	177.3	16.8	19.0	23.9	127.5	8.1	20.9	115.1	34.4	36.7	92.6	102.8	13.8	23.8	7.2	4.8		
SD	24.3	5.9	3.8	7.8	35.3	3.0	5.5	57.4	4.8	5.5	22.3	23.2	5.9	15.0	5.2	3.4		

Note. Decimal points are omitted for correlation coefficients.

Table 20

BAB Test Intercorrelations for White Group (Lower Triangle, N=275) and Total Group (Upper Triangle, N=445)

BAB Test	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total Mean	Total SD
1. Clerical	—	20	09	11	30	06	24	25	13	23	-12	-10	11	24	34	27	177.8	24.0
2. Idea F.	24	—	39	05	16	43	57	52	16	16	02	04	39	57	50	51	20.6	8.4
3. Induct. R.	03	27	—	11	-01	40	41	28	16	19	07	08	38	47	39	41	20.8	3.7
4. Word A.	15	00	09	—	04	08	00	09	05	11	-07	-08	08	10	16	07	23.6	8.4
5. Writing S.	35	24	-04	01	—	00	10	22	15	18	-10	-08	03	08	08	06	138.8	39.5
6. Paper F.	02	22	35	08	-04	—	57	32	07	08	16	17	61	59	56	63	9.2	4.7
7. Vocabulary	23	42	33	-03	19	41	—	51	14	13	00	04	42	64	60	65	26.3	12.4
8. Ideaphoria	33	41	16	09	42	08	39	—	23	17	-10	-09	27	43	51	46	126.2	65.6
9. FD-L.	16	16	19	-03	25	01	12	23	—	51	06	01	24	16	22	14	35.6	4.8
10. FD-R.	32	19	18	10	29	08	13	18	54	—	-06	-03	22	21	18	20	39.4	5.1
11. Grip-L.	-13	-05	02	-12	01	14	-03	-14	07	-04	—	91	20	04	-02	07	99.9	26.1
12. Grip-R.	-10	-01	06	-12	03	17	01	-13	06	01	91	—	24	04	01	11	108.6	26.9
13. Shape A.	07	18	34	04	04	53	23	02	17	19	25	31	—	53	44	53	15.2	7.1
14. Analyt. R.	22	42	38	09	10	45	47	26	16	26	-02	-02	38	—	60	66	28.5	16.4
15. Num. I	36	32	23	14	14	43	46	37	24	22	-04	00	28	45	—	74	9.2	5.8
16. Num. II	27	32	26	05	11	48	49	28	15	23	06	10	38	52	65	—	7.0	5.4
White:																		
Mean	181.0	23.9	21.8	23.9	141.6	11.0	31.7	148.6	36.1	40.0	100.9	110.0	17.6	35.8	11.6	9.6		
SD	22.1	7.8	3.3	8.8	27.7	4.4	12.0	63.9	4.4	5.0	26.1	27.6	6.4	14.6	5.1	4.8		

Note. Decimal points are omitted for correlation coefficients.

Table 21

BAB Test Intercorrelations for Female Group (Upper Triangle, N=222) and Male Group (Lower Triangle, N=223)

BAB Test	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Female Mean	Female SD
1. Clerical	—	12	08	07	22	03	21	20	12	19	-12	-09	14	24	30	23	183.0	25.1
2. Idea F.	31	—	46	-01	05	39	56	60	23	22	11	09	42	59	49	53	20.7	8.5
3. Induct. R.	12	31	—	13	-05	43	48	39	15	24	05	07	46	52	47	46	20.8	3.8
4. Word A.	13	13	10	—	00	10	-02	04	03	04	-01	-06	13	09	17	04	24.1	8.8
5. Writing S.	36	32	05	07	—	-07	-03	02	09	08	05	-02	-02	-04	-08	-07		
6. Paper F.	18	49	38	07	14	—	55	40	03	04	10	08	59	57	57	61	8.5	4.6
7. Vocabulary	28	57	33	02	28	60	—	54	18	15	-01	-01	44	68	63	69	26.6	12.7
8. Ideaphoria	24	46	17	13	43	32	49	—	34	24	03	-04	42	55	60	60	139.2	63.3
9. FD-L.	14	09	16	07	22	14	09	11	—	48	08	02	29	16	29	20	35.8	5.0
10. FD-R.	24	09	13	17	27	16	12	07	55	—	-01	04	26	20	23	23	40.0	5.1
11. Grip-L.	10	-05	08	-08	-05	04	02	02	14	02	—	85	06	01	02	-01	83.6	16.7
12. Grip-R.	14	02	10	-07	06	08	10	09	08	05	85	—	09	-01	00	00	92.2	18.3
13. Shape A.	21	38	30	07	21	60	44	26	23	26	03	09	—	59	52	54	13.2	6.9
14. Analyt. R.	27	56	40	11	27	61	60	35	17	23	02	04	48	—	67	72	27.9	17.4
15. Num. I	36	52	31	14	25	59	58	42	14	12	05	14	45	53	—	76	9.7	5.8
16. Num. II	38	50	37	11	25	65	63	39	10	21	03	10	51	59	75	—	6.5	5.4
Male:																		
Mean	172.6	20.6	20.9	23.1	132.6	9.9	26.1	113.3	35.4	38.9	115.8	124.8	17.1	29.2	8.6	7.4		
SD	21.8	8.2	3.5	7.9	33.5	4.6	12.0	65.5	4.6	5.0	23.7	24.1	6.8	15.4	5.6	5.4		

Note. Decimal points are omitted for correlation coefficients.

Table 22

Factor Loading Matrix of BAB Tests for High School Freshmen (N=445)

BAB Test	Factor I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	h^2
Clerical	-	-	-	56	-	-	-	-	-	-	-	-	-	46
Idea F.	68	-	-	-	-	-	-	-	-	-	-	-	-	63
Induct. R.	55	-	-	-	-	-	-	-	-	-	-	-	-	41
Word A.	-	-	-	-	-	-	46	-	-	-	-	-	-	22
Writing S.	-	-	-	54	-	-	-	-	-	-	-	-	-	34
Paper F.	73	-	-	-	-	-	-	-	40	-	-	-	-	77
Vocabulary	80	-	-	-	-	-	-	-	-	-	-	-	-	77
Ideaphoria	48	-	-	-	-	47	-	-	-	-	-	-	-	58
FD-L.	-	-	77	-	-	-	-	-	-	-	-	-	-	67
FD-R.	-	-	71	-	-	-	-	-	-	-	-	-	-	61
Grip-L.	-	96	-	-	-	-	-	-	-	-	-	-	-	95
Grip-R.	-	96	-	-	-	-	-	-	-	-	-	-	-	95
Shape A.	60	-	-	-	-	-	-	46	-	-	-	-	-	67
Analyt. R.	81	-	-	-	-	-	-	-	-	-	-	-	-	72
Num. I	64	-	-	-	61	-	-	-	-	-	-	-	-	66
Num. II	76	-	-	-	36	-	-	-	-	32	-	-	-	83

Note. Only coefficients $\geq |.30|$ are entered. Decimal points are omitted.

Table 23

Factor Loading Matrix of BAB Tests for Black High School Freshmen (N=127)

BAB Test	Factor I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	h^2
Clerical	-	-	-	-	-	-	-	-	-	61	-	-	-	43
Idea F.	-	31	-	-	-	-	-	-	64	-	-	-	-	63
Induct. R.	-	-	-	-	-	69	-	-	-	-	-	-	-	66
Word A.	-	-	-	-	-	-	-	-	-	-	58	-	-	37
Writing S.	-	-	-	-	-	-	68	-	-	-	-	-	-	55
Paper F.	-	-	-	59	-	-	-	-	-	-	-	-	-	55
Vocabulary	-	79	-	-	-	-	-	-	-	-	-	-	-	81
Ideaphoria	-	-	-	-	-	-	-	65	-	-	-	-	-	47
FD-L.	-	-	78	-	-	-	-	-	-	-	-	-	-	67
FD-R.	-	-	69	-	-	-	-	-	-	-	-	-	40	73
Grip-L.	95	-	-	-	-	-	-	-	-	-	-	-	-	95
Grip-R.	94	-	-	-	-	-	-	-	-	-	-	-	-	93
Shape A.	-	-	30	59	-	-	-	-	-	-	-	-	-	55
Analyt. R.	-	74	-	-	-	-	-	-	-	-	-	-	-	79
Num. I	-	-	-	-	-	-	-	-	-	-	-	56	-	54
Num. II	-	-	-	-	71	-	-	-	-	-	-	-	-	66

Note. Only coefficients $\geq |.30|$ are entered. Decimal points are omitted.

Table 24

Factor Loading Matrix of BAB Tests for Hispanic High School Freshmen (N=42)

BAB Test	Factor I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	h^2
Clerical	-	-	-	-	-	-	37	-	-	72	-	-	-	72
Idea F.	-	-	-	-	36	-	-	-	-	-	62	-	-	61
Induct. R.	-	-	-	-	-	-	-	73	-	-	-	-	-	76
Word A.	-	-	-	-	-	-	-	-	65	-	-	-	-	46
Writing S.	-	-	-	-	-	-	85	-	-	-	-	-	-	79
Paper F.	-	-	-	69	-	-	-	-	35	-	34	-	-	96
Vocabulary	-	-	67	-	-	-	-	-	-	-	-	-	-	59
Ideaphoria	-	-	-	-	88	-	-	-	-	-	-	-	-	87
FD-L.	-	77	-	-	30	-	-	-	-	-	-	-	-	84
FD-R.	-	86	-	-	-	-	-	-	-	-	-	-	-	88
Grip-L.	95	-	-	-	-	-	-	-	-	-	-	-	-	98
Grip-R.	92	-	-	-	-	-	-	-	-	-	-	-	-	94
Shape A.	-	-	-	82	-	32	-	-	-	-	-	-	-	96
Analyt. R.	-	-	-	-	-	81	-	-	-	-	-	-	-	87
Num. I	-	-	52	-	36	-	-	-	37	32	-	34	-	98
Num. II	-	-	70	-	-	-	-	34	-	-	-	-	-	86

Note. Only coefficients $\geq |.30|$ are entered. Decimal points are omitted.

Table 25

Factor Loading Matrix of BAB Tests for White High School Freshmen (N=275)

BAB Test	Factor I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	h^2
Clerical	-	-	39	-	-	-	-	-	50	-	-	-	-	55
Idea F.	-	-	37	-	-	36	-	-	-	-	-	30	-	48
Induct. R.	-	-	-	-	-	61	-	-	-	-	-	-	-	46
Word A.	-	-	-	-	-	-	52	-	-	-	-	-	-	28
Writing S.	-	-	67	-	-	-	-	-	-	-	-	-	-	52
Paper F.	-	37	-	-	63	-	-	-	-	-	-	-	-	71
Vocabulary	-	43	-	-	-	42	-	-	-	31	-	-	-	64
Ideaphoria	-	-	70	-	-	-	-	-	-	-	-	-	-	63
FD-L.	-	-	-	77	-	-	-	-	-	-	-	-	-	71
FD-R.	-	-	-	74	-	-	-	-	-	-	-	-	-	71
Grip-L.	96	-	-	-	-	-	-	-	-	-	-	-	-	97
Grip-R.	96	-	-	-	-	-	-	-	-	-	-	-	-	98
Shape A.		-	-	-	65	-	-	-	-	-	-	-	-	58
Analyt. R.	-	39	-	-	32	32	-	48	-	-	-	-	-	63
Num. I	-	81	-	-	-	-	-	-	-	-	-	-	-	79
Num. II	-	75	-	-	-	-	-	-	-	-	-	-	-	73

Note. Only coefficients $\geq |.30|$ are entered. Decimal points are omitted.

Table 26

Factor Loading Matrix of BAB Tests for Female High School Freshmen (N=222)

BAB Test	Factor I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	h^2
Clerical	-	-	-	66	-	-	-	-	-	-	-	-	-	54
Idea F.	65	-	-	-	-	-	-	35	-	-	-	-	-	70
Induct. R.	50	-	-	-	-	-	-	-	45	-	-	-	-	54
Word A.	-	-	-	-	47	-	-	-	-	-	-	-	-	22
Writing S.	-	-	-	-	-	-	57	-	-	-	-	-	-	35
Paper F.	70	-	-	-	-	-	-	-	-	-	36	-	-	79
Vocabulary	83	-	-	-	-	-	-	-	-	-	-	-	-	82
Ideaphoria	62	-	-	-	-	-	-	51	-	-	-	-	-	71
FD-L.	-	-	77	-	-	-	-	-	-	-	-	-	-	71
FD-R.	-	-	69	-	-	-	-	-	-	-	-	-	-	57
Grip-L.	-	93	-	-	-	-	-	-	-	-	-	-	-	93
Grip-R.	-	94	-	-	-	-	-	-	-	-	-	-	-	91
Shape A.	55	-	-	-	-	59	-	-	-	-	-	-	-	75
Analyt. R.	81	-	-	-	-	-	-	-	-	-	-	-	-	81
Num. I	78	-	-	-	33	-	-	-	-	-	-	-	-	91
Num. II	88	-	-	-	-	-	-	-	-	-	-	-	-	87

Note. Only coefficients $\geq |.30|$ are entered. Decimal points are omitted.

Table 27

Factor Loading Matrix of BAB Tests for Male High School Freshmen (N=223)

BAB Test	Factor I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	h^2
Clerical	-	-	-	-	58	-	-	-	-	-	-	-	-	47
Idea F.	49	-	40	-	-	-	-	-	-	-	-	32	-	64
Induct. R.	35	-	-	-	-	-	50	-	-	-	-	-	-	40
Word A.	-	-	-	-	-	-	-	49	-	-	-	-	-	27
Writing S.	-	-	64	-	-	-	-	-	-	-	-	-	-	60
Paper F.	84	-	-	-	-	-	-	-	-	-	-	-	-	73
Vocabulary	63	-	36	-	-	-	-	-	-	38	-	-	-	77
Ideaphoria	-	-	71	-	-	-	-	-	-	-	-	-	-	63
FD-L.	-	-	-	78	-	-	-	-	-	-	-	-	-	68
FD-R.	-	-	-	76	-	-	-	-	-	-	-	-	-	71
Grip-L.	-	93	-	-	-	-	-	-	-	-	-	-	-	94
Grip-R.	-	93	-	-	-	-	-	-	-	-	-	-	-	93
Shape A.	68	-	-	-	-	-	-	-	-	-	-	-	-	54
Analyt. R.	65	-	-	-	-	-	-	-	40	-	-	-	-	73
Num. I	56	-	-	-	-	59	-	-	-	-	-	-	-	78
Num. II	66	-	-	-	33	45	-	-	-	-	-	-	-	89

Note. Only coefficients $\geq |.30|$ are entered. Decimal points are omitted.

Table 28

Factor Loading Matrix of BAB Tests for Non-White High School Freshmen (N=170)

BAB Test	Factor I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	h^2
Clerical	-	-	-	-	-	-	63	-	-	-	-	32	-	45
Idea F.	-	-	-	35	49	-	-	-	-	-	-	-	-	60
Induct. R.	-	-	-	-	-	66	-	-	-	-	-	-	-	53
Word A.		-	-	-	-	-	-	-	-	51	-	-	-	29
Writing S.	-	-	-	-	-	-	-	63	-	-	-	-	-	46
Paper F.	-	66	-	-	-	-	-	-	-	-	-	-	-	62
Vocabulary	-	-	-	73	-	-	-	-	-	-	-	-	-	69
Ideaphoria	-	-	-	-	57	-	-	-	-	-	-	-	-	39
FD-L.	-	-	74	-	-	-	-	-	-	-	-	-	-	62
FD-R.	-	-	72	-	-	-	-	-	-	-	-	-	-	58
Grip-L.	96	-	-	-	-	-	-	-	-	-	-	-	-	97
Grip-R.	94	-	-	-	-	-	-	-	-	-	-	-	-	94
Shape A.	-	71	-	-	-	-	-	-	-	-	-	-	-	67
Analyt. R.	-	34	-	54	-	31	-	-	-	-	33	-	-	65
Num. I	-	-	-	-	35	-	-	-	53	35	-	-	-	77
Num. II	-	45	-	-	-	32	-	-	41	-	-	-	-	64

Note. Only coefficients $\geq |.30|$ are entered. Decimal points are omitted.

Table 29

Highest Factor Loadings and Communalities for Each BAB Test by Race and Sex Group

BAB Test	Black			Hispanic			White			Female			Male		
	HL	h^2	F	HL	h^2	F	HL	h^2	F	HL	h^2	F	HL	h^2	F
Clerical	61	43	10	72	72	10	50	55	9	66	54	4	58	47	5
Idea F.	64	63	9	62	61	11	37	48	3	65	70	1	49	64	1
Induct. R.	69	66	6	73	76	8	61	46	6	50	54	1	50	40	7
Word A.	58	37	11	65	46	9	52	28	7	47	22	5	49	27	8
Writing S.	68	55	7	85	79	7	67	52	3	57	35	7	64	60	3
Paper F.	59	55	4	69	96	4	63	71	5	70	79	1	84	73	1
Vocabulary	79	81	2	67	59	3	43	64	2	83	82	1	63	77	1
Ideaphoria	65	47	8	88	87	5	70	63	3	62	71	1	71	63	3
FD-L.	78	67	3	77	84	2	77	71	4	77	71	3	78	68	4
FD-R.	69	73	3	86	88	2	74	71	4	69	57	3	76	71	4
Grip-L.	95	95	1	95	98	1	96	97	1	94	93	2	93	94	2
Grip-R.	94	93	1	92	94	1	96	98	1	94	91	2	93	93	2
Shape A.	59	55	4	82	96	4	65	58	5	59	75	6	68	54	1
Analyt. R.	74	79	2	81	87	6	48	63	8	81	81	1	65	73	1
Num. I	56	54	12	52	98	3	81	79	2	78	91	1	59	78	6
Num. II	71	66	5	70	86	3	75	73	2	88	87	1	66	89	1

Note. N's = 127 blacks, 42 hispanics, 275 whites, 222 females, 223 males. HL = highest factor loading (decimal point omitted); h^2 = communality; F = factor identification number.

Table 30

Coefficients of Factor Congruence Between Race, Sex and Age Groups, by Factor

Factor	Group Comparisons among Freshmen		Group Comparisons Between Freshmen and Seniors			
	B vs. W	F vs. M	F vs. F	M vs. M	B vs. B	W vs. W
Grip	.973	.975	.988	.974	.964	.988
Finger D.	.953	.936	.933	.978	.934	.976
Spatial	.948	---	---	---	.924	.965
Idea F.	---	---	---	---	.849	---
Ideaph.	.701	---	---	.947	.882	.922
Word A.	.800	.780	.834	.784	.820	.898
Clerical	.865	.840	.851	.902	.817	.796
Induct. R.	.794	---	---	.892	.727	.797
Vocabulary	---	---	---	---	.840	---
Analyt. R.	.837	---	---	---	.696	.897
Writing S.	.548	---	---	---	.861	---
Num. I	.810	---	---	---	---	---
Num. II	.763	---	---	---	---	---

Note. B = black, W = white, F = female, M = male. Dashes signify that the factor did not appear in the factor analyses.

Table 31

Descriptive Statistics for Highly Speeded BAB Tests

Test	Mean	Median	Skew	SD	Range
Clerical	177.78	177.88	-.891	24.01	80 to 238
Idea Fluency	20.64	20.28	+.350	8.37	1 to 45
Word Assoc.	23.57	24.00	-.042	8.36	2 to 46
Writing Speed	138.75	135.15	2.13	39.48	33 to 351
Ideaphoria	126.22	123.17	+.358	65.63	9 to 334
FD.-Left	35.59	35.68	+.090	4.83	23 to 51
FD.-Right	39.41	39.74	-.283	5.11	20 to 54
Grip-Left	99.88	96.10	+.570	26.07	33 to 193
Grip-Right	108.62	104.70	+.501	26.92	38 to 189

Table 32

Suggested Format for Freshman Vocabulary Test

Item	p-value	Discrimination
4	.86	.43
7	.86	.41
2*	.80	.40
5*	.80	.38
14	.79	.52
2	.79	.48
12	.79	.47
56	.74	.50
11	.72	.44
1*	.71	.44
4*	.71	.46
13	.70	.44
41	.70	.35
14*	.69	.45
8	.69	.47
31	.69	.35
33	.68	.35
27	.64	.56
3*	.63	.44
25	.63	.37
36	.61	.46
21	.67	.32
28	.59	.67
10*	.58	.45
26	.58	.53
30	.58	.51
69	.58	.39
19*	.57	.30
10	.57	.47
42	.57	.35
23	.56	.48
22	.55	.48
35	.54	.58
13*	.53	.40
8*	.52	.53
26*	.52	.36
24	.52	.55
43	.52	.55
71	.52	.50
80	.52	.49
42*	.51	.34
37	.51	.51
50	.50	.30

Table 32 (Continued)

Item	p-value	Discrimination
32	.50	.53
39	.49	.47
12*	.49	.48
35*	.48	.30
17	.48	.62
45	.48	.41
52	.48	.44
63	.48	.45
65	.48	.49
39*	.47	.53
17*	.45	.35
53	.45	.41
58	.44	.49
76	.43	.47
7*	.42	.55
30*	.42	.38
40	.42	.48
49	.42	.43
97	.42	.47
18*	.40	.39
38	.40	.54
57	.40	.41
21*	.38	.53
44	.38	.50
85	.37	.46
11*	.36	.40
59	.35	.44
107	.34	.44
20	.34	.44
33*	.33	.43
60	.31	.44
81	.31	.47
25*	.30	.63
23*	.28	.40
28*	.28	.41
15*	.27	.54
51	.27	.55

*Denotes item from BAB Vocabulary; other items are from Research Vocabulary.

Table 33

Frequency Distributions of Item Difficulties and Discrimination Indices for Suggested Freshman Vocabulary and Numerical Reasoning Tests

Index[a]	Freshman Vocabulary		Freshman Numerical Reasoning	
	Diff.	Disc.	Diff.	Disc.
.90 - .99	-	-	-	-
.80 - .89	4	-	-	-
.70 - .79	9	-	2	1
.60 - .69	9	3	7	9
.50 - .59	22	19	4	9
.40 - .49	21	42	4	1
.30 - .39	11	16	2	1
.20 - .29	4	-	1	-
.10 - .19	-	-	-	-
.00 - .09	-	-	-	-

[a]Item difficulty is the proportion passing the item; item discrimination is r_{pbis} between item and total score.

Table 34

Suggested Format for Freshman Scale
Numerical Reasoning Test

Item	p-value	Discrimination
4	.79	.54
14	.75	.60
12	.69	.50
18*	.67	.63
10*	.65	.62
17	.65	.56
16	.64	.51
7	.64	.52
9*	.61	.60
11	.59	.62
15*	.56	.70
26*	.56	.46
20*	.50	.57
23*	.49	.60
24*	.43	.60
28*	.43	.62
21*	.41	.63
35*	.36	.59
31*	.37	.51
22*	.29	.54

*Also on Washburne Scale

Table 35

Suggested Format for Auditory Memory Test for Freshmen

Item Number	Item Length (digits)	Item Difficulty
18	6	.63
9	6	.54
6	7	.43
21	7	.46
16	7	.42
28	7	.40
24	8	.40
13	8	.32
20	8	.28
10	8	.24

Table 36

Suggested New Format for
Visual Memory Span Test

Examples:	504
	839
Warmup:	964
(unscored)	4923
	34675
Beginning of	012683
scored test -	799352
6 digits:	670765
7 digits:	2349172
	4728865
	1471362
	9216538*
8 digits:	53886164
	23407281
	24935648
	49720685*
	65042908*
9 digits:	788643646
	741269019
	319261488
	816594327*
	619573084*
	241967025*
10 digits:	1041102372
	6519009072
	5208316479*
	1309628745*
	9421360857*
	3082165947*
	3814761549*

*Suggested additional slides not included in current Visual Memory Span.

Appendix A

Construction of Experimental Tests

Construction of Experimental Tests

Five experimental tests were developed by the Ball Foundation as a part of the present study. The tests are: (a) Associative Memory, (b) Auditory Memory Span, (c) Visual Memory Span, (d) Facial Memory, and (e) Research Vocabulary. This appendix contains a brief description of each test, followed by a summary of the test's construction and further development.

Associative Memory. The Associative Memory test measures the ability to recall immediately the letter originally paired with a number after studying a list of number/letter pairs.

The construction of the Associative Memory test was straightforward. It was decided that the test administration time should be short (preferably less than 5 minutes), yet the test should contain a sufficient number of items to discriminate among test-takers of widely varying levels of skill. Another concern was the format of the items themselves. Numbers, letters, words, abstract symbols, and pictures of common objects were all considered as possible test material.

The final form of the test consisted of 13 randomly chosen letter/number pairs. The numbers were selected with the additional stipulation that no digit appear more often than any other digit. The resulting number/letter pairs were inspected to eliminate any obviously meaninful relationships, such as "10 X."

A copy of the Associative Memory test is included at the end of this section.

Auditory Memory Span. The Auditory Memory Span test measures the ability to remember series of digits presented auditorily by means of a pre-recorded tape.

Three important decisions to be made in the development of the Auditory Memory Span test were (a) the length of each digit series, (b) the number of digit spans of each length, and (c) the scoring method, i.e., "total credit" or "partial credit" scoring. Total credit scoring assigns one point for every correctly recalled digit series of any length, such that the number of possible points is equal to the number of digit series. The partial credit scoring method gives one point for every correctly remembered digit with a series, regardless of series length or the correctness of other digits within the same series. For any given test, then, the partial scoring method will always yield a much higher score than the total credit scoring method.

All number series were generated using a random number table. Recordings of test material were made at WETN, the Wheaton College radio station in Wheaton, Illinois.

The first version of the Auditory Memory Span test consisted of 24 digit series ranging from 3 to 10 digits in length, with three series of each length. The series were presented in ascending order of length, from shortest to longest. Copies of the test format and answer sheet are placed at the end of this Appendix.

The Auditory Memory Span test was first administered to a group of 48 freshman girls and scored using the partial credit method. The results of an item analysis of item difficulties indicated that the series containing 3 to 5 digits were answered correctly by over 95% of the

test-takers. It was also observed that item difficulties increased with series length for series of 6 or more digits.

A second Auditory Memory Span test was constructed with fewer easy items and more items of intermediate and greater difficulty. The new version contained 28 number series, with series lengths distributed as shown in Table A.1. The first three series, containing 3, 4, and 5

Insert Table A.1 about here

---

digits, respectively, served an as unscored "warm-up" to the rest of the test. The remaining 25 series of 6 or more digits were presented in random order without regard to series length.

The second test version was administered to several freshman groups and scored by both the partial credit and total credit methods. The results of the data analyses are presented in Appendix C.

Visual Memory Span. The Visual Memory Span measures the ability to remember series of digits presented visually by means of slides projected onto a screen.

The construction of the two memory spans paralleled each other in several respects. The three decisions listed in the Auditory Memory Span section were equally relevant to the construction of the Visual Memory Span test. A random number table was used to generate the number series. Twenty-four series were selected, ranging from 3 to 10 digits in length, with three series of each length. The series were presented in ascending order of length, from shortest to longest.

Two sets of slides, an original and a duplicate, were prepared. The test was administered by projecting the slides onto a screen using a

Kodak carousel projector. The allotted presentation time was the same for every series (0.08 minutes), regardless of series length. After each presentation, a blank slide was shown as a cue to test-takers to write down what they could recall from the previously viewed slide. Slide changes were made manually by a test administrator with the help of a stopwatch.

The Visual Memory Span test protocols were scored using both the partial credit and total credit scoring methods. The results of an item analysis are presented in Appendix C.

Facial Memory. The Facial Memory test measures the ability to recognize a set of previously studied reference Identi-Kit faces from a larger set of both old and new faces. The recognition tests were administered immediately after the study period and again after a half-hour of unrelated testing.

The construction of the Facial Memory test required consideration of the following issues: (a) the production of a large number of life-like faces, (b) the number of composition of the probe faces, and (c) the number and composition of the distractor faces.

Several methods for obtaining pictures were considered, including artist's drawings, yearbook pictures, and the Identi-Kit. The Identi-Kit was chosen because of the control it allows over the choice of facial features and the relative ease with which faces could be constructed. Eighty-three faces were created, all Caucasian and approximately half of each sex. Within each sex, five hairstyles and two or three sets of eyes, noses, mouths, and chins were chosen and combined in

various ways judged to appear most natural-looking. The exact composition of each face is listed at the end of Appendix A.

Because of the uniqueness of the Facial Memory test, the optimal number of probe faces and distractor faces were unknown. Two forms were developed: the shorter form consisted of 7 probe faces and 11 distractor faces (the 7/18 form). The longer form consisted of 9 probe faces and 14 distractor faces (the 9/23 form). Within each form, the probe faces were selected to be as different as possible. Distractor faces were chosen to resemble the probe faces in one or more of the five facial dimensions. For example, a distractor face might share with a probe face a hairstyle, eyes and mouth, but different in its nose and chin. Approximately half of the selected probe and distractor faces were male, half female.

Photographs and negatives of the 83 Identi-Kit faces were prepared by Ball Advertising. For each form the faces were reproduced full-size for the study period, and reduced to 67% for the recognition tests.

Research Vocabulary. The Research Vocabulary test measures the ability to choose the word that represents an idea.

It was considered that the BAB Vocabulary test in its present form would be too difficult for high school freshmen. The Research Vocabulary test was constructed to develop a vocabulary test approporiate to the freshmen level. One hundred and twenty-six multiple choice items were selected from the 400-item pool used in the development of the BAB Vocabulary test. The items were chosen according to the criteria of difficulty levels greater than .55 and discrimination functions greater than .20. There was no overlap of items between the BAB and Research

Vocabulary tests. For the 235 freshmen taking both tests, a new pool of 206 items was formed to become the basis for a Freshmen Vocabulary test. At the end of this Appendix a copy of Research Vocabulary and detailed information about each test item is given.

Table A.1

Frequency of Series by Series Length
for Auditory Memory Span Test

Series Length (number of digits)	Frequency
3	1
4	1
5	1
6	3
7	4
8	5
9	6
10	7

BALL APTITUDE BATTERY

ASSOCIATIVE MEMORY

NAME: _____
(Last) (First) (Middle)

AGE: _____ HEIGHT: _____ WEIGHT: _____

SEX: MALE _____ FEMALE _____

SCHOOL/COMPANY: _____ GRADE: _____

JOB TITLE/DEPARTMENT: _____

ETHNIC GROUP: BLACK _____ HISPANIC _____

NATIVE AMERICAN _____ WHITE _____ OTHER _____

DATE: _____

BALL FOUNDATION

800 ROOSEVELT ROAD

GLEN ELLYN, ILLINOIS 60137

ASSOCIATIVE MEMORY

This is a test of Associative Memory. It measures your ability to associate numbers and letters. Your job is to study pairs of numbers and letters and then recall the letter that was matched with each number.

Here is an example: Below is a list of paired numbers and letters. For practice, study and memorize these pairs during the next 15 seconds.

Number	Letter
24	A
67	Z
36	K

Stop. The time is up. Turn to the next page and then write the letter next to its matching number.

For number 67 you should have filled in the letter "Z," for number 36, the letter "K," and for number 24, the letter "A."

You will be given 2 minutes to study and memorize 13 pairs of numbers and letters. When the time is up, you will turn to the next page that has the same numbers, but in a different order. Your job is to recall which letter was matched with each number on the page before, and then write the letter next to the number.

Are there any questions?

Example:

Number	Letter
67	_____
36	_____
24	_____

STUDY LIST

Number	Letter
23	L
57	R
98	Q
70	G
82	W
65	E
41	S
38	M
51	C
14	H
79	J
26	P
94	X

STOP. DO NOT TURN THIS PAGE UNTIL ASKED TO DO SO.

TEST PAGE

Number	Letter
82	
26	
57	
14	
65	
23	
54	
79	
51	
98	
41	
38	
70	

BALL APTITUDE BATTERY

AUDITORY MEMORY SPAN

NAME: _____
(Last) (First) (Middle)

AGE: _____ HEIGHT: _____ WEIGHT: _____

SEX: MALE _____ FEMALE _____

SCHOOL/COMPANY: _____ GRADE: _____

JOB TITLE/DEPARTMENT: _____

ETHNIC GROUP: BLACK _____ HISPANIC _____

NATIVE AMERICAN _____ WHITE _____ OTHER _____

DATE: _____

BALL FOUNDATION

800 ROOSEVELT ROAD

GLEN ELLYN, ILLINOIS 60137

AUDITORY MEMORY SPAN

This test is called Auditory Memory Span. It measures your ability to listen to a series of numbers and remember it. For each problem on the test you will hear a series of numbers from a tape recording. Each series is heard only once, so listen carefully. When you hear a tone, pick up your pencil and quickly write down the numbers in their right order in the boxes on the answer sheet.

Here is an example. Listen to the series of numbers and wait until the tone sounds. Then write the numbers, one per box, on your answer sheet.

Example:

If you remember the series correctly, your answer would look like this:

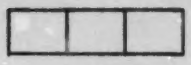
Example:

1	4	5

Be sure to wait until you hear the tone before writing the numbers down. Leave your pencil on the desk while each series is being read. If you are not sure of a number in a series, write down your best guess.

Are there any questions?

When told to do so, turn the page and begin.

1. 
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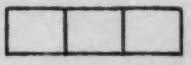
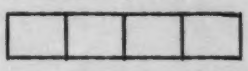
3. 
4. 
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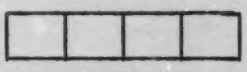
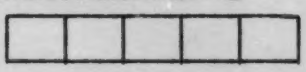
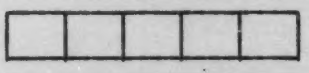
6. 
7. 
8. 
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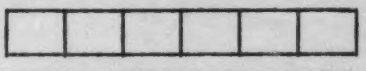
10. 
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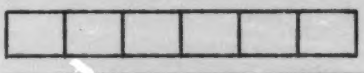
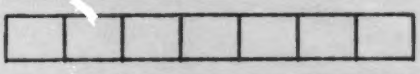
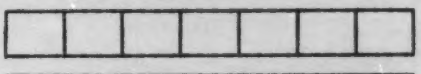
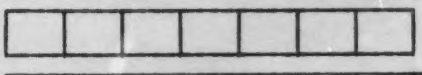
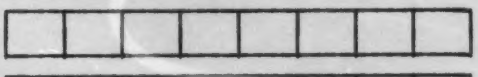
12. 
13. 
14. 
15. 
16. 
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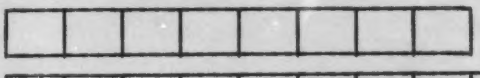
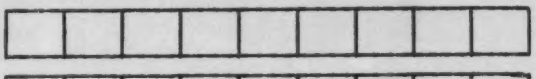
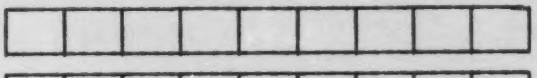
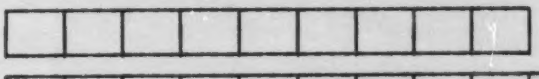
18. 
19. 
20. 
21. 
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BALL APTITUDE BATTERY

AUDITORY MEMORY SPAN

NAME: _____
(Last) (First) (Middle)

AGE: _____ HEIGHT: _____ WEIGHT: _____

SEX: MALE _____ FEMALE _____

SCHOOL/COMPANY: _____ GRADE: _____

JOB TITLE/DEPARTMENT: _____

ETHNIC GROUP: BLACK _____ HISPANIC _____

NATIVE AMERICAN _____ WHITE _____ OTHER _____

DATE: _____

BALL FOUNDATION

800 ROOSEVELT ROAD

GLEN ELLYN, ILLINOIS 60137

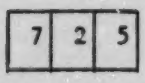
AUDITORY MEMORY SPAN

This test is called Auditory Memory Span. It measures your ability to listen to a series of numbers and remember it. For each problem on the test you will hear a series of numbers from a tape recording. Each series is heard only once, so listen carefully. When you hear a tone, pick up your pencil and quickly write down the numbers in their right order in the boxes on the answer sheet.

Here is an example. Listen to the series of numbers and wait until the tone sounds. Then write the numbers, one per box, on your answer sheet.

Example:

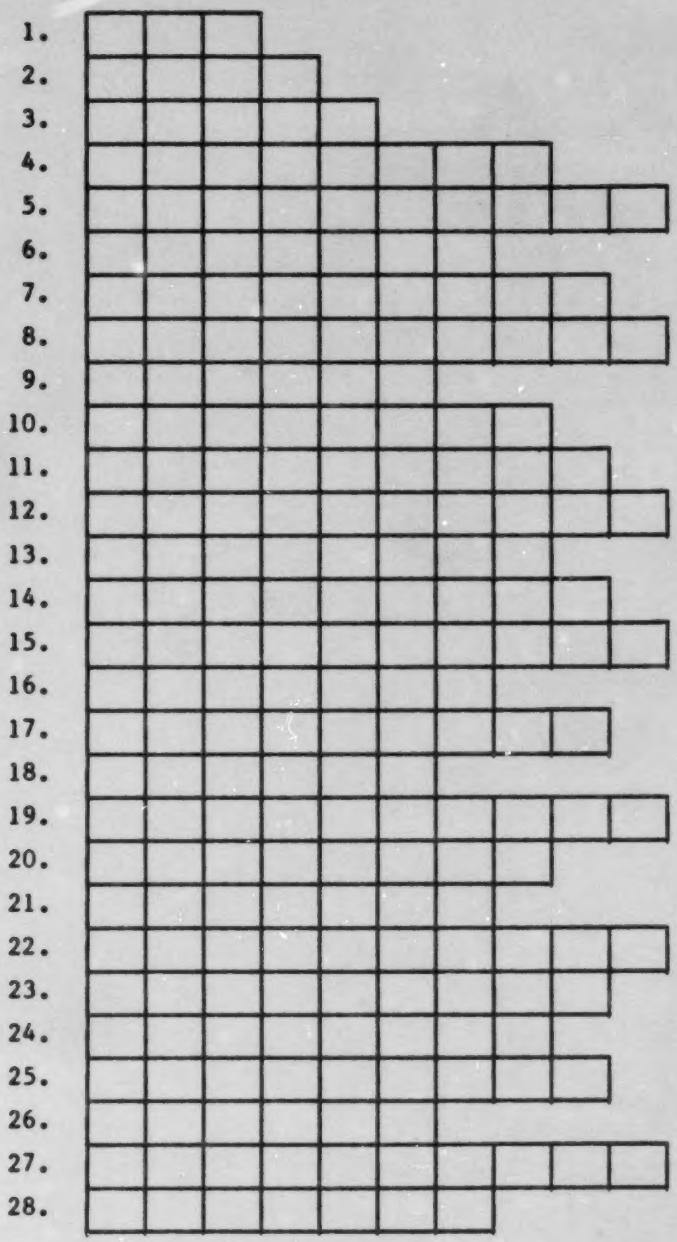
If you remember the series correctly, your answer would look like this:

Example: 

Be sure to wait until you hear the tone before writing the numbers down. Leave your pencil on the desk while each series is being read. If you are not sure of a number in a series, write down your best guess.

Are there any questions?

When told to do so, turn the page and begin.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BALL APTITUDE BATTERY

VISUAL MEMORY SPAN

NAME: _____
(Last) (First) (Middle)

AGE: _____ HEIGHT: _____ WEIGHT: _____

SEX: MALE _____ FEMALE _____

SCHOOL/COMPANY: _____ GRADE: _____

JOB TITLE/DEPARTMENT: _____

ETHNIC GROUP: BLACK _____ HISPANIC _____

NATIVE AMERICAN _____ WHITE _____ OTHER _____

DATE: _____

BALL FOUNDATION

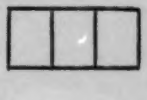
800 ROOSEVELT ROAD

GLEN ELLYN, ILLINOIS 60137

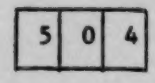
VISUAL MEMORY SPAN

This test is called Visual Memory Span. It measures your ability to look at a series of numbers and remember it. For each problem on the test you will see a series of numbers projected on a screen. Each series is shown only once, so take a good look. When the slide changes and you hear the click, pick up your pencil and quickly write down the numbers in their right order in the boxes on the answer sheet.

Here is an example. Look at the series of numbers and wait until the slide changes. Then write the numbers, one per box, on your answer sheet.

Example: 

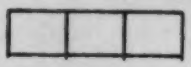
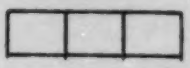
If you remember the series correctly, your answer would look like this:

Example: 

Be sure to wait until the slide changes and you hear the click before writing the numbers down. Leave your pencil on the desk while each series is being shown. If you are not sure of a number in a series, write down your best guess.

Are there any questions?

When told to do so, turn the page and begin.

1.
2. 
3. 
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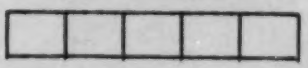
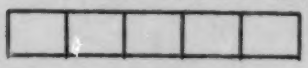
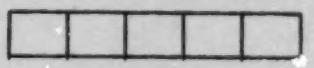
7. 
8. 
9. 
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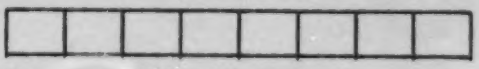
16. 
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FACIAL MEMORY

This is a test of Facial Memory. It measures how well you can study some pictures of faces and later remember what you saw.

You will be asked to look at 7 faces for one minute. Then you will hand in your paper. Next you will receive a paper with many faces on it. Some of the faces will be the same as the ones you just saw, and some will be different. Your job is to pick the 7 faces that are exactly the same as the ones shown before. Mark an X in the parentheses next to each picture you saw before. If you are not sure, make your best guess. You will have 1-1/2 minutes to find the seven faces.

Later, after some other tests, you will be asked to pick out those seven faces again.

Are there any questions?

7/18 II

NAME: _____

.AME :

NAME: _____ 7/18 III

FACIAL MEMORY

(Delayed)

A while ago you studied some pictures of faces, and were tested on how well you could remember them.

Now you will be given another set of many faces and asked to pick out the 7 faces you saw the first time. The pictures are in a different order than they were for the first test. Just like before, mark an X in the parentheses next to the 7 pictures you studied at first. If you are not sure, make your best guess. You will have 1-1/2 minutes to find the 7 faces.

Are there any questions?

9/23 I

FACIAL MEMORY

This is a test of Facial Memory. It measures how well you can study some pictures of faces and later remember what you saw.

You will be asked to look at 9 faces for one minute. Then you will hand in your paper. Next you will receive a paper with many faces on it. Some of the faces will be the same as the ones you just saw, and some will be different. Your job is to pick the 9 faces that are exactly the same as the ones before. If you are not sure, make your best guess. You will have 1-1/2 minutes to find the nine faces.

Later, after some other tests, you will be asked to pick out those nine faces again.

Are there any questions?

9/23 II

NAME: _____

NAME: _____ 9/23 III

FACIAL MEMORY

(Delayed)

A while ago you studied some pictures of faces, and were tested on how well you could remember them.

Now you will be given another set of many faces and asked to pick out the 9 faces you saw the first time. The pictures are in a different order than they were for the first test. Just like before, mark an X in the parentheses next to the 9 pictures you studied at first. If you are not sure, make your best guess. You will have 1-1/2 minutes to find the 9 faces.

Are there any questions?

BALL APTITUDE BATTERY

VOCABULARY

NAME: _____
(Last) (First) (Middle)

AGE: _____ HEIGHT: _____ WEIGHT: _____

SEX: MALE _____ _____ FEMALE _____

SCHOOL/COMPANY: _____ GRADE: _____

JOB TITLE/DEPARTMENT: _____

ETHNIC GROUP: BLACK _____ HISPANIC _____

NATIVE AMERICAN _____ WHITE _____ OTHER _____

DATE: _____

BALL FOUNDATION

800 ROOSEVELT ROAD

GLEN ELLYN, ILLINOIS 60137

VOCABULARY

This is a Vocabulary test. It measures your knowledge of English vocabulary. Each test word is underlined and used in a phrase. From five choices your are to put an X in front of the one which is most similar in meaning to the test word. Below is a sample problem, marked correctly:

His courteous behavior

( ) aristocratic

(X) polite

( ) rude

( ) slow

( ) stiff

You will be given 35 minutes for this test. Work quickly and accurately.

Are there any questions?

Turn the page and begin.

VOCABULARY

1. he clarified his statement
( ) published
( ) contradicted
( ) withdrew
( ) revised
( ) made clear

2. the souvenir of our visit
( ) memento
( ) incident
( ) story
( ) recency
( ) purpose

3. will you adopt my plan
( ) develop
( ) accept
( ) change
( ) reject
( ) consider

4. he was penalized
( ) led astray
( ) questioned
( ) punished
( ) rewarded
( ) isolated

5. his reliability
( ) morality
( ) word
( ) trustworthiness
( ) intelligence
( ) obligation

6. I suspect him
( ) envy
( ) dislike
( ) distrust
( ) honor
( ) recommend

7. transfer your residence
( ) mortgage
( ) tear down
( ) decorate
( ) relocate
( ) acquire

8. the earth's axis
( ) outer rim
( ) size
( ) motion
( ) rotation pole
( ) orbit

9. a question of chastity
( ) purity
( ) embellishment
( ) riches
( ) indecency
( ) royalty

10. rational assurance
( ) logical
( ) public
( ) absurd
( ) unalterable
( ) incomplete

11. a public accountant
( ) news gatherer
( ) nuisance
( ) stenographer
( ) bookkeeper
( ) official

12. the centennial festival
( ) costly
( ) hundred year
( ) two year
( ) brilliant
( ) three day

13. several recurrent ideas
( ) unique
( ) frequently appearing
( ) modern
( ) popular
( ) well-known

14. the sturdy little fellow
( ) cunning
( ) strong
( ) friendly
( ) delicate
( ) stupid

15. what is the temperature
( ) climate
( ) degree of heat
( ) atmosphere
( ) thermometer
( ) humidity

16. the sudden perception
( ) unconsciousness
( ) awareness
( ) birth
( ) meeting
( ) idea

17. usually tranquil
( ) secretive
( ) grateful
( ) flashy
( ) serene
( ) drugged

18. somewhat belated
( ) overdue
( ) ragged
( ) misled
( ) happy
( ) woeful

19. it was repaired
( ) sold
( ) lost
( ) adjusted
( ) broken
( ) mended

20. gutteral sounds
( ) high pitched
( ) precise
( ) booming
( ) throaty
( ) nauseating

21. he was sanctified
( ) ordained
( ) made holy
( ) profaned
( ) crucified
( ) condemned

22. the flora of the Sierras
( ) minerals
( ) plants
( ) wild animals
( ) flying insects
( ) strata

23. selected the incentive
( ) celebration date
( ) motive
( ) best idea
( ) expert
( ) candidate

24. went on monotonously
( ) sleepily
( ) alone
( ) unchangingly
( ) excitedly
( ) irregularly

25. suitably placed
( ) inconveniently
( ) properly
( ) foolishly
( ) comfortably
( ) highly

26. nothing could budge him
( ) touch
( ) stir
( ) reach
( ) stop
( ) annoy

27. studied the extinction
( ) disease
( ) growth
( ) death
( ) honor
( ) grave site

28. what obese children
( ) obedient
( ) stupid
( ) fat
( ) thin
( ) attractive

29. subdue the enemy
( ) spy on
( ) splinter
( ) overcome
( ) besiege
( ) surrender to

30. suburban districts
( ) city
( ) aristocratic
( ) thinly settled
( ) factory
( ) outlying

31. consulted the agent
( ) seller
( ) man
( ) oracle
( ) representative
( ) owner

32. the town has deteriorated
( ) altered
( ) improved
( ) developed
( ) degenerated
( ) disappeared

33. the forgotten felons
( ) youths
( ) fruits
( ) old men
( ) criminals
( ) cats

34. in the gully
( ) boat
( ) low hill
( ) ditch
( ) pond
( ) cave

35. intricate design
( ) ornamental
( ) classic
( ) weird
( ) complex
( ) artistic

36. known tomb
( ) statue
( ) vault
( ) church
( ) identity
( ) death notice

37. heard it toll
( ) bang
( ) fall down
( ) sound
( ) die
( ) revolve

38. unexpected homage
( ) hatred
( ) household
( ) seniority
( ) respect
( ) gift

39. he was fond of intrigue
( ) pastry
( ) plotting
( ) plain dealing
( ) society
( ) fortune telling

40. could not be omnipotent
( ) false
( ) worn out
( ) rude
( ) gruff
( ) all powerful

41. outrageous manners
( ) boorish
( ) shocking
( ) foreign
( ) polished
( ) extraordinary

42. covenant arrived at
( ) sale
( ) agreement
( ) nunnery
( ) judgment
( ) obstacle

43. responsible for the hoax
( ) false step
( ) deception
( ) mess
( ) stoppage
( ) crime

44. they merged often
( ) split
( ) pushed
( ) clashed
( ) bleeded
( ) rose

45. methodical arrangement
( ) gospel
( ) systematic
( ) linear
( ) denominational
( ) careless

46. he relinquished his claim
( ) gave up
( ) enjoyed
( ) repeated
( ) wrote out
( ) neglected

47. a special citation
( ) urban area
( ) passing over
( ) rebuke
( ) honorable mention
( ) asking

48. he has many qualms
( ) pets
( ) duties
( ) successes
( ) misgivings
( ) inquiries

he made sacrifices
( ) amends
( ) promises
( ) self-denials
( ) false statements
( ) efforts

her clothes were disheveled
( ) soiled
( ) disordered
( ) inharmonious
( ) badly made
( ) spotless

he is unconcerned
( ) inexperienced
( ) indifferent
( ) not connected
( ) involved
( ) unappreciated

he can cope with him enemies
( ) eliminate
( ) agree
( ) run
( ) work
( ) contend adequately

elated expression
( ) loud
( ) slow
( ) excited
( ) sad
( ) depressed

his prefatory notes
( ) academic notes
( ) future payment
( ) unfinished
( ) literary
( ) introductory

rebut the argument
( ) reaffirm
( ) support
( ) rearrange
( ) conclude
( ) refute

this is sleazy
( ) flimsy
( ) well-woven
( ) rain-proof
( ) substantial
( ) smooth

57. expected aridity
( ) sourness
( ) dryness
( ) speed
( ) moisture
( ) odor

58. the big conch
( ) canoe
( ) belly
( ) shell
( ) thirst
( ) bed

59. he planned the ode
( ) message
( ) novel
( ) house
( ) poem
( ) drama

60. celebrate the occasion
( ) pass by
( ) talk over
( ) observe
( ) think about
( ) bless

61. organized extensively
( ) effectively
( ) accurately
( ) widely
( ) inadequately
( ) richly

62. transcribe these notes
( ) cross out
( ) improve
( ) exchange
( ) explain
( ) copy

63. certain hybrids
( ) graftings
( ) crossbreeds
( ) imported stock
( ) offshoots
( ) thoroughbreds

64. to be wary
( ) watchful
( ) afraid
( ) tired
( ) sad
( ) sinewy

65. with no sequel
( ) trimming
( ) contination
( ) duplicate
( ) uniformity
( ) hidden meaning

66. his candid manner
( ) sly
( ) faltering
( ) frank
( ) superficial
( ) sugared

67. an unusual protuberance
( ) grimace
( ) wound
( ) swelling
( ) hollowness
( ) distance

68. agreed on coalition
( ) signing
( ) mutual problems
( ) parting
( ) union
( ) cancellation

69. ludicrous thoughts
( ) dismal
( ) ridiculous
( ) brilliant
( ) transparent
( ) profitable

70. pertinent remarks
( ) rude
( ) appropriate
( ) discreet
( ) unsuitable
( ) wise

71. sinister shapes
( ) unusual
( ) misformed
( ) shadowy
( ) evil
( ) ghostly

72. sultry days
( ) oppressively hot
( ) calm
( ) cloudy
( ) discouraging
( ) chilly

3. sustained the drive
( ) stopped
( ) completed
( ) questioned
( ) continued
( ) slowed

4. he seemed deranged
( ) mad
( ) bad mannered
( ) tardy
( ) hurt
( ) unclear

5. famous epic
( ) history
( ) tragedy
( ) heroic poem
( ) comedy
( ) critical essay

6. his futile attempt
( ) worthless
( ) successful
( ) childish
( ) desperate
( ) planned for

7. picturesque in its way
( ) fake
( ) flashy
( ) quaint
( ) holding water
( ) old-fashioned

8. schism of sects
( ) union
( ) division
( ) project
( ) convention
( ) dictrine

9. these unpleasant mores
( ) races
( ) precepts
( ) marshes
( ) customs
( ) half wits

0. they rummaged it
( ) searched
( ) handled
( ) scrapped
( ) sold
( ) ruined

81. listening to the saga
( ) prairie wind
( ) good advice
( ) chief
( ) cruel story
( ) heroic narrative

82. inexplicable facts
( ) perceptible
( ) unforgiveable
( ) unaccountable
( ) undiscoverable
( ) doubtful

83. lengthy invocation
( ) job
( ) lecture
( ) pleasure trip
( ) prayer
( ) waiting period

84. signs of lethargy
( ) hate
( ) robbery
( ) inheritance
( ) weariness
( ) poor health

85. the unnoticed rent
( ) hollow
( ) raving
( ) perfume
( ) patch
( ) tear

86. they were premeditated
( ) accused
( ) hospitalized
( ) negotiated
( ) extemporized
( ) considered

87. subject to scrutiny
( ) torture
( ) pressure
( ) scorn
( ) observation
( ) danger

88. spoke of temperance
( ) excessive drinking
( ) hording
( ) moderation
( ) personality
( ) anger

89. try to deduce
( ) persuade
( ) predict
( ) entice
( ) eliminate
( ) conclude

90. lengthy dissertation
( ) journey
( ) historical document
( ) coffee break
( ) silence
( ) essay

91. to evoke the spirits
( ) glorify
( ) forget
( ) anger
( ) elude
( ) summon

92. strange genesis
( ) upbringing
( ) child
( ) outcome
( ) source
( ) Bible

93. impinging interests
( ) independent
( ) conflicting
( ) temporary
( ) cooperative
( ) close

94. he was disquieted
( ) quizzed
( ) unruly
( ) heartened
( ) worried
( ) stilled

95. the composite photograph
( ) negative
( ) made up
( ) actual
( ) crowded
( ) well designed

96. the unforeseen exhumation
( ) degrading
( ) burial
( ) fatigue
( ) court order
( ) digging up

. long infested
( ) established
( ) deposited
( ) hospitalized
( ) overrun
( ) remembered

. a paragon of beauty
( ) model
( ) geometric figure
( ) statue
( ) judge
( ) burlesque

. his tour was pleasant
( ) home
( ) manner
( ) visit
( ) game
( ) journey

. decadent cultures
( ) dead
( ) violent
( ) deteriorating
( ) conquered
( ) modern

. impervious to water
( ) admitting passage
( ) impenetrable
( ) oppressed
( ) accustomed
( ) unaccustomed

. a certain relevancy
( ) inappropriateness
( ) support
( ) vigor
( ) applicability
( ) importance

. a desirable statute
( ) law
( ) monument
( ) physique
( ) document
( ) constitution

the island's circuit
( ) plaza
( ) area
( ) harbour
( ) boundary
( ) entertainment

105. offered expiation
( ) regret
( ) defiance
( ) expulsion
( ) amends
( ) voyage

106. monolithic monument
( ) important
( ) ancient
( ) black
( ) painted
( ) one stone

107. act of nullity
( ) old age
( ) force
( ) sinfulness
( ) insignificance
( ) usefulness

108. overt expeditions
( ) criminal
( ) open
( ) treasonable
( ) unlawful
( ) crooked

109. the proximity of others
( ) nearness
( ) unity
( ) distance
( ) position
( ) looseness

110. it was tainted
( ) dumped
( ) infected
( ) adorned
( ) seasoned
( ) complained about

111. this case is typical
( ) similar
( ) representative
( ) rare
( ) different
( ) special

112. an audacious young man
( ) contemptible
( ) foolish
( ) bold
( ) timid
( ) boastful

113. brusquely drawn
( ) slowly
( ) abruptly
( ) comically
( ) gingerly
( ) heavily

114. what impetuous fellows
( ) considerate
( ) rash
( ) insolent
( ) cautious
( ) sulky

115. to be intimidated
( ) released
( ) hinted
( ) overawed
( ) admonished
( ) polluted

116. addressing the laity
( ) churchmen
( ) brotherhood
( ) professional
( ) lawyers
( ) laymen

117. she was perturbed
( ) comforted
( ) interrupted
( ) discouraged
( ) disappointed
( ) disquieted

118. much affluence
( ) power
( ) speed
( ) coming together
( ) illness
( ) wealth

119. ascertain his reasons
( ) write out
( ) ignore
( ) trust
( ) state
( ) find out

120. coagulating about it
( ) plotting
( ) circling
( ) arguing
( ) thickening
( ) grouping

121. they were contending
( ) planning
( ) visiting
( ) struggling
( ) resting
( ) guarding

122. incarnations of evil
( ) predictions
( ) embodiments
( ) rumors
( ) provocations
( ) spirits

123. resented their antipathy
( ) onslaught
( ) dislike
( ) worry
( ) fondness
( ) sympathy

124. archaic ideas
( ) structural
( ) Egyptian
( ) unusual
( ) contemporary
( ) bygone

125. synchronous views
( ) simultaneous
( ) peculiar
( ) timely
( ) integrating
( ) chronological

126. a strong antithesis
( ) development
( ) similarity
( ) dislike
( ) contrast
( ) dissertation

Appendix B

Item Statistics of Selected BAB Tests

INDUCTIVE REASONING

	Freshmen	Seniors
Mean:	20.84	22.4
SD:	3.66	3.6

No. of items: 30

Median: 21.10

Range: 9, 29

Skewness: -.472

Mean item diff.: .69

Reliability estimates

	Total	Males	Females
alpha	.62	.57	.65
split-half	.59	.53	.63

Item Discrimination Index	.00-.09	.10-.19	.20-.29	.30-.39	.40-.49	.50-.59	.60-.69	.70-.79	.80-.89	90+
.60+										
.50-.59										
.40-.49										
.30-.39						9				
.20-.29					19, 24	26	10, 11, 14, 17, 25		18	1,2,3, 4, 15, 16
.10-.19				29, 30	28	20, 27	7, 21	8, 12, 22, 23	6	5
.00-.09										
Below .00								13		

Item Difficulty

VOCABULARY

	Freshmen	Seniors
ean:	26.32	36.7
):	12.37	16.2

No. of items: 80

Median: 23.86

Range: 6, 79

Skewness: +1.10

Mean item diff.: .33

Reliability estimates

	Total	Males	Females
alpha	.91	.90	.91
split-half	.82	.86	-

.60+				25						
.50-.59			15, 50	21	7, 39	8				
.40-.49		41, 61	23, 28, 29	11, 33	12	10, 13	3, 14	1, 4	2	
.30-.39		44, 45, 56, 60	20, 27, 36, 57, 58, 69	16, 22, 34, 43, 53	17, 18, 30, 35	19, 26 42			5, 6	
.20-.29		48, 52, 62, 64, 78, 72, 73, 76	32, 46, 47, 59, 63, 68, 71, 74, 75, 79	31, 49	37, 38					
.10-.19	70	51, 67, 77	40, 54		9, 50, 55					
.00-.09	80		65							
Below .00			66							
	.00-.09	.10-.19	.20-.29	.30-.39	.40-.49	.50-.59	.60-.69	.70-.79	.80-.89	90+

Item Difficulty

PAPER FOLDING

	Freshmen	Seniors
Mean:	9.18	10.8
SD:	4.67	5.1

No. of items: 24

Median: 9.07

Range: 0, 24

Skewness: +.392

Mean item diff.: .38

Reliability estimates	Total	Males	Females
alpha	.80	.78	.80
split-half	.70	.67	.72

Note: There was a fairly abrupt decrease in number of responses after item 20, corresponding to the page turn.

Item Discrimination Index	.00-.09	.10-.19	.20-.29	.30-.39	.40-.49	.50-.59	.60-.69	.70-.79	.80-.89	90+
.60+										
.50-.59				15						
.40-.49		13	14, 8	6, 7, 9, 10	4, 5		1			
.30-.39		18	12, 19		3	2				
.20-.29	16	20		11						
.10-.19	21	23	17							
.00-.09	22, 24									
Below .00										

Item Difficulty

SHAPE ASSEMBLY

	Freshmen	Seniors
Mean:	15.16	14.9
SD:	7.08	7.5

No. of items: 6

Median: 15.34

Range: 0, 30

Skewness: -.066

Mean item diff.: .74

Reliability estimates

	Total	Males	Females
alpha	.60	.55	.62
split-half	.57	.54	.58

Item Discrimination Index	.00-.09	.10-.19	.20-.29	.30-.39	.40-.49	.50-.59	.60-.69	.70-.79	.80-.89	90+
.60+										
.50-.59										
.40-.49							4		5	
.30-.39							6			
.20-.29						3			1, 2	
.10-.19										
.00-.09										
Below .00										

Item Difficulty

ANALYTICAL REASONING

	Freshmen	Seniors
Mean:	28.54	32.3
SD:	16.42	16.1

No. of items: 18

Median: 27.35

Range: 0, 76

Skewness: +.352

Mean item diff.: .44

Reliability estimates

	Total	Males	Females
alpha	.77	.73	.79
split-half	.71	.69	.73

Item Discrimination Index	.00-.09	.10-.19	.20-.29	.30-.39	.40-.49	.50-.59	.60-.69	.70-.79	.80-.89	90+
.60+										
.50-.59					10					
.40-.49					11, 13, 16	7				
.30-.39		17	12, 14, 15, 18	9	5		3, 6			
.20-.29				4						2
.10-.19								1		
.00-.09						8				
Below .00										

Item Difficulty

NUMERICAL I
(FULL SCALE)

	Freshmen	Seniors
Mean:	17.75	-
SD:	8.11	-

No. of items: 40

Median: 17.08

Range: 2, 37

Skewness: +.243

Mean item diff.: .44

Reliability estimates	Total	Males	Females
alpha	.92	.91	.92
split-half	.80	.79	.81

Item Discrimination Index	.00-.09	.10-.19	.20-.29	.30-.39	.40-.49	.50-.59	.60-.69	.70-.79	.80-.89	90+
.60+			28	23, 24, 25	13, 27	17				
.50-.59		29, 34	26, 30, 31, 32, 22		14, 21	19, 20	11			
.40-.49		33			16	4, 15, 18		6		
.30-.39	35, 36, 37							9, 10		
.20-.29	39							8, 12	5, 7	
.10-.19	38									1, 2, 3
.00-.09										
Below .00										

Item Difficulty

NUMERICAL I
(WASHBURNE SCALE)

	Freshmen	Seniors
Mean:	9.16	-
SD:	5.76	-

No. of items: 20

Median: 9.03

Range: 0, 20

Skewness: +.076

Mean item diff.: .46

Reliability estimates	Total	Males	Females
alpha	.91	.90	.91
split-half	.85	.85	.85

Item Discrimination Index	.00-.09	.10-.19	.20-.29	.30-.39	.40-.49	.50-.59	.60-.69	.70-.79	.80-.89	90+
.60+				23, 24, 25	13, 14, 27	17, 20				
.50-.59			22, 26, 30		21	19	11			
.40-.49			31			4, 15, 18	16			
.30-.39										
.20-.29								12		
.10-.19										
.00-.09										
Below .00										

Item Difficulty

NUMERICAL II
(FULL SCALE)

	Freshmen	Seniors
Mean:	17.65	-
SD:	8.11	-

No. of items: 43

Median: 17.08

Range. 0, 37

Skewness: +.243

Mean item diff.: .45

Reliability estimates	Total	Males	Females
alpha	.94	.94	.94
split-half	.79	.77	.80

Item Discrimination Index	.00-.09	.10-.19	.20-.29	.30-.39	.40-.49	.50-.59	.60-.69	.70-.79	.80-.89	90+
.60+			29	28	23	11, 15	10, 18	13, 14		
50-.59		32, 37	22, 25, 39	31, 35	20, 21, 24, 43	9, 26	7, 17	4	3	
.40-.49		27, 33, 38, 40	30				16, 12		6, 8	
.30-.39	34, 36, 41, 44								5	1
.20-.29	42									2
.10-.19										
.00-.09										
Below .00										

Item Difficulty

NUMERICAL II
(WASHBURNE SCALE)

	Freshmen	Seniors
Mean:	6.99	-
SD:	5.39	-

No. of items: 20

Median: 6.31

Range: 0, 20

Skewness: +.476

Mean item diff.: .35

Reliability estimates	Total	Males	Females
alpha	.91	.91	.91
split-half	.82	.81	.82

Note: Modal score was zero.

Item Discrimination Index	.00-.09	.10-.19	.20-.29	.30-.39	.40-.49	.50-.59	.60-.69	.70-.79	.80-.89	90+
.60+		32	29	28	23		18			
.50-.59		27, 33	22, 25	31, 35	20, 21, 24	9	10, 15			
.40-.49						26				
.30-.39	34, 36									
.20-.29										
.10-.19										
.00-.09										
Below .00										

Item Difficulty

Appendix C

Item Statistics of Experimental Tests

AUDITORY MEMORY SPAN

	Freshmen	Seniors
Mean:	7.26	-
SD:	5.98	-

No. of items: 25

Median:

Range: 0, 24

Skewness: +1.04

Mean item diff.: .29

Reliability estimates	Total	Males	Females
alpha	.90	-	-
split-half	.85	-	-

Note: Mean Item Difficulty by Series Length

Series Length	Mean Item Difficulty
6	.52
7	.43
8	.29
9	.21
10	.18

Item Discrimination Index	.00-.09	.10-.19	.20-.29	.30-.39	.40-.49	.50-.59	.60-.69	.70-.79	.80-.89	90+
.60+		19	7, 11, 14, 15, 17, 22							
.50-.59		4, 8, 12, 25	5, 10		6					
.40-.49		23, 27	20	13	16, 21, 24		18			
.30-.39						9				
.20-.29					28					
.10-.19				26						
.00-.09										
Below .00										

Item Difficulty

VISUAL MEMORY SPAN

	Freshmen	Seniors
Mean:	17.01	-
SD:	3.69	-

No. of items: 24
Median:
Range: 9, 24
Skewness: +.092
Mean item diff.: .71

Reliability estimates	Total	Males	Females
alpha	.81	-	-
split-half	.45	-	-

Note: Mean Item Difficulty by Series Length

Series Length	Mean Item Difficulty
3	.99
4	.99
5	.97
6	.87
7	.72
8	.45
9	.37
10	.31

Item Discrimination Index

	.00-.09	.10-.19	.20-.29	.30-.39	.40-.49	.50-.59	.60-.69	.70-.79	.80-.89	90+
.60+				21, 24						
.50-.59			22	19	20					
.40-.49				23	16	17				
.30-.39				18			13, 14	15		
.20-.29									10, 12	
.10-.19										4, 7
.00-.09										2, 5,8, 9, 11
Below .00										1, 3

Item Difficulty

RESEARCH VOCABULARY

	Freshmen	Seniors
Mean:	54.71	-
SD:	22.82	-

No. of items: 126

Median: 53.75

Range: 14, 122

Skewness: +.430

Mean item diff.: .43

Reliability estimates	Total	Males	Females
alpha	.95	-	-
split-half	.88	-	-

Item Discrimination Index

	.00-.09	.10-.19	.20-.29	.30-.39	.40-.49	.50-.59	.60-.69	.70-.79	.80-.89	90+
.60+					17	28				
.50-.59			51	44	32, 38	24, 26, 30, 35, 37, 43, 71	27	14, 56		
.40-.49		117, 124	89, 92, 106, 126	45, 54, 59, 60, 66, 81, 85, 86, 107,20	39, 40, 45, 49, 52, 53, 57, 58, 63, 65, 76, 97	10, 22, 23, 80	8, 36	2, 5, 11, 12, 13, 16	4, 7	
.30-.39		96, 102	68, 88, 103, 109, 116	64, 72, 7-, 91, 98, 101 112, 114,121	9, 93	42, 50, 69	21, 25, 31, 33, 41	6, 19, 29	15	
.20-.29		70, 90, 118	55, 83, 84, 87, 95, 105 122,123	61, 67, 74, 77, 78, 94, 100,104 113,115	62, 83	47	34		1, 3	
.10-.19		111, 120, 125	108, 110	46, 79, 99			18			
.00-.09			75							
Below .00										

Item Difficulty

Appendix D

A Study of Freshman SDS Scores

Study of Fresman SDS Scores

Occupational interests of freshmen were measured with a research form of Holland's Self-Directed Search. Means and standard deviations for each of the six occupational themes are shown in Table D.1. The results for the total group were compared to Holland's adult norm sample,

Insert Table D.1 about here

in which scores were standardized to a mean of 50 and a standard deviation of 10. The freshman means were somewhat depressed, ranging from a low 39.12 for Realistic to a high of 44.94 for Enterprising. Freshman standard deviations were close to the standardized standard deviation of 10.

Means and standard deviations were also calculated for the two sex groups. Females scored higher on the Artistic, Social, and Enterprising themes, while males received a higher mean score on the Realistic theme.

Intercorrelations among the six themes for the total group are shown in Table D.2. The correlations are generally high, ranging from

Insert Table D.2 about here

.31 to .76, with a median r of .49. The pattern of correlations showed a rough correspondence to Holland's model of occupational interests, in which the degree of commonality between any two themes varies inversely with the distance separating their positions on the hexagonal model.

Table D.3 shows correlations between BAB and SDS scores for the total sample. Most correlations were near zero, with only eight greater

Insert Table D.3 about here

than $|.20|$. The highest correlations were between Vocabulary and Investigative (.35) and Grip-Left and Right and Realistic (.27 and .29).

Table D.1

Means and Standard Deviations for Males, Females, and Total Group, by SDS Occupational Interest Theme

SDS Theme	Total Group (N = 356)		Males (N = 177)		Females (N = 179)	
	Mean	SD	Mean	SD	Mean	SD
Realistic	39.12	9.88	43.49	9.16	34.80	8.60
Investigative	36.12	11.21	37.16	12.33	35.08	9.91
Artistic	43.97	10.07	41.47	9.43	46.48	10.10
Social	42.49	10.13	39.18	10.09	45.77	9.07
Enterprising	44.94	8.94	44.34	9.45	45.52	8.40
Conventional	43.80	11.15	41.34	11.37	46.23	10.40

Table D.2

Intercorrelations Among Holland's Occupational Interest Themes (N=356)

Theme	1.	2.	3.	4.	5.	6.	Mean	SD
1. Realistic	-						39.12	9.88
2. Investigative	.46	-					36.12	11.21
3. Artistic	.31	.55	-				43.97	10.07
4. Social	.33	.46	.59	-			42.49	10.13
5. Enterprising	.50	.49	.53	.67	-		44.94	8.94
6. Conventional	.38	.55	.46	.68	.76	-	43.80	11.15

Table D.3

Correlations Between BAB and SDS Scores (N=356)

BAB Test	SDS Occupational Interest Theme					
	Realistic	Investigative	Artistic	Social	Enterprising	Conventional
Clerical	-21	00	-02	02	-02	00
Idea Fluency	01	14	13	12	07	-07
Induc. Reasoning	02	16	14	04	00	-02
Word A.	-10	-04	-06	-04	-07	03
Writing S.	-16	-02	-02	05	01	00
Paper Folding	10	21	06	-02	-04	-05
Vocabulary	02	35	21	17	09	06
Ideaphoria	-14	17	18	22	07	05
F.D.-Left	08	08	09	19	15	13
F.D.-Right	-07	01	-01	11	00	05
Grip-Left	27	08	-09	-03	12	04
Grip-Right	29	11	-12	-06	09	-07
Shape A.	14	13	01	-10	-02	-06
Analyt. Reasoning	-01	22	13	06	-02	-07
Num. I	-04	19	07	15	07	03
Num. II	03	24	00	03	08	00

Note. Decimal points are omitted.